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A POPULAR EXPLANATION OF A RATIONAL BASIS OF COMPARING GAS AND ELECTRIC LIGHTING.

By G. C. Shadwell.

The question has often been asked, how many men could compute, with a reasonable degree of accuracy, the real cost of gas lighting as compared with any other form of lighting. For example, how many commercial men are there who know how to make such a comparison, and upon what to base their figures? Should a comparison be made between the candle-power of one as against the candle-power of the other; and if so, what sort of candle-power? Or should the relation be on candle-power-hours? In other words, what should be the *basis* of comparison?

Let us consider first how gas is purchased: We pay so much for a certain quantity of it, and it is supplied under certain conditions, which differ according to local conditions. Whatever else we pay for, *quantity* is one of the factors, and is usually the main one. Is it not therefore reasonable to suppose that light should be paid for mainly by quantity? For a clear understanding of the question it is of first importance to understand clearly the meaning and nature of the quantities and units involved.

Our earliest ideas give us a conception of *power*. Power is just the rate of doing work, in the same way as velocity is the rate of motion of a body or the rate of gas flowing in a pipe. There are several units of power, depending on whether it is mechanical, electrical or otherwise. If the power be mechanical its practical unit is usually the horse-power (H.P.); or if electrical, the watt or kilowatt (1 kilowatt = 1000 watts). There is a definite relationship between mechanical horse-power and electrical horse-power, 746 watts being equal to 1 horse-power. It will readily be seen that similar relationships may be shown between other quantities. Work being accomplished by energy, both are measured in the same units. Bearing in mind, then, that a watt is a unit of power, and that power is the rate of doing work or the rate of giving out or taking in energy, we define a watt-hour as a unit of energy (or work). It is an electrical unit, but as there are connecting links between mechanical and electrical units, a watt-hour is equivalent to a certain fraction of a *horse-power-hour*.

Again, as a British thermal unit (B. T. U.) is a measure of the energy in gas, and as gas has so many B. T. U.'s per cubic foot, we should be able to obtain a connecting link between B. T. U.'s per hour and watts. Be careful to note the difference between these units—a B. T. U. (per cubic foot) is a unit of *energy*. The *watt-hour and kilowatt-hour (or kelvin, as the latter is sometimes called,)* are also units of *energy*. A watt, however, is a unit of power, as is *B. T. U. per hour*.

This, then, gives us another connecting link between two things we have already learned. There is, however, one trouble, electric lamps are not rated in B. T. U.'s or in watt-hours, but in *units of power*. As electric lamps are usually rated in watts, it is reasonable that gas lamps should be rated in B. T. U.'s per hour; if both are rated in units of power a definite relationship can be established between them.

Having decided on part of a method of comparison, let us consider another factor. We usually speak of a gas or an electric lamp as having so many candle-power. But candle-power is not always associated with the energy consumed. Still, to any one considering the question a little, it will be obvious that to consider one factor without the other gives nothing that is relative. An electric lamp may be spoken of as having an efficiency of so many watts per candle-power (although rightly this should be expressed in candle-power per watt); similarly a gas lamp might be rated at so many candle-power per *B. T. U. per hour*, provided both candle-powers were mean-spherical (that is to say total candle-power). The candle-powers would be comparable (being both of a kind) and the power would be comparable, for 1 watt = 3.415 B. T. U.'s per hour, or 1 B. T. U. per hour = 0.292....watt. Candle-power, however, is an undesirable unit, and a basis of lumens is preferable.

A *lumen* is a unit of *quantity of light-flux*; simply a unit like any other measure, such as a pound or an inch. The reason for the confusion that often arises in its consideration is hard to find. It is possible that the average man fails to understand the lumen in its relation to other units.

Hence, first of all, the candle-power. *Candle-power* is a unit of *luminous intensity; just as an ampere is a unit of current intensity*. It is a curious thing that because 1 candle-power is a unit of luminous intensity, the average man speaks of "amount of candle-power." Such an expression is as intelligent as speaking of "amount of feet," or "amount of pounds."

The writer thinks it desirable, therefore, to tabulate the following units, as generally illustrative ones, together with the quantity of which each is a unit:

The Unit's Name.	What it is a Unit of.
1 foot (′–0″).	Length (lineal).
1 square foot (′–0″)².	Area.
1 cubic foot (1′–″)³.	Volume.
1 pound (1 lb.).	Weight, mass.
1 foot-pound (1 ft.-lb.).	Energy (Mechanical).*
1 foot-pound.	Work (Mechanical).*
1 British thermal unit (1 B.T.U.).	Energy (Heat).
1 kilowatt-hour (1 kw. hr.)	Energy (Electrical).
1 horse-power-hour (1 h. p. h.).	Energy (Mechanical).
1 horse-power (1 h. p.).	Power (The rate of doing work) (Mechanical).
1 kilowatt (1 kw.).	Power (Electrical).
1 candle-power (1 c. p.).	Light intensity.
1 ampere.	Electrical current intensity.
1 foot-candle.	Illumination intensity.
1 gilbert.	Magnetic flux.
1 lumen.	Light flux.

* Measures of work and energy are the same.

This shows in a general way the analogy between common physical units.

Let us now consider the derivation of the value of the lumen, and its relation to other light units. We should remember, first of all, to speak of a lamp as having so much light intensity, and not so much candle-power. Secondly, we should remember that a lamp gives out quantity of light-flux, and that such quantity is measured in lumens.

Now, electrical quantity is measured in coulombs or ampere hours, and $Q = I\,t$ (or quantity is the product of current intensity and time during which the current flows). But quantity of light-flux is not measured by intensity of light, times the time it (light) flows (if one may talk of light as flowing). In other words, if L =

lumens, t = time and C = candle-power (mean spherical)[1], then L = C t, is, in effect, a misuse of terms.

We see, for instance, that a lumen does *not* embody a factor of time any more than a kilowatt does; but a kilowatt-hour embodies time, and so does a lumen-hour. So that a *lumen-hour* is a unit of quantity of light, just as a coulomb or an ampere-hour are units of electrical quantity.

Having this clearly in mind, we can consider the derivation of the lumen still further. A lamp has a certain candle-power. If it were a point-source the candle-power would be the same from whatever angle viewed. As, however, it is never a point-source, but only approximates that, it has a different candle-power at different points. So that the mean of the candle-powers in *all* directions is the *mean spherical* candle-power. That is, the mean of all the candle-powers all around it spherically. Bear in mind that candle-power does not *flow*, nor is it radiated. It is a unit of *light intensity*. Quantity of light is radiated (or *flows* if the expression is preferred) and quantity of light is measured in lumen-hours, as mentioned above.

Suppose then, that we have a lamp at *A*, Fig. 1, and a floor $BB'B''B'''$ to illuminate by it. Then if the distance from the light source to the point directly below it be *ab*, we will have a certain *illumination* (note the new term) at *b*. We will get illumination all over the floor $BB'B''B'''$, but it will be different at different points.

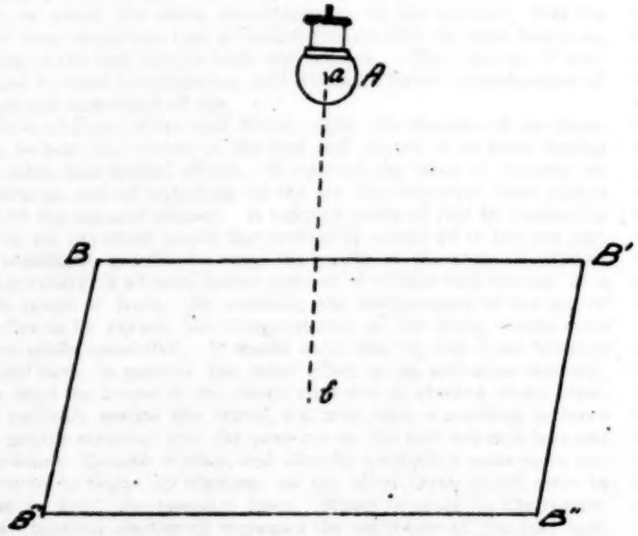

Fig. 1.

Now, let us see what *illumination* is. We know the lumen is a unit of total light-flux; and that a foot is a unit of length. We also know that mean spherical candle-power is a unit of light intensity. So, if the distance *ab* = 1 foot, and the lamp[2] at *a*, has 1 mean spherical candle-power (1 m.s.c.p.) of light intensity, then we will have an illumination at *b* of 1 foot-candle. Now we could have tied up the lumen right away, if only we did not live on flat floors.

Just suppose we live on floors that are *not* flat—suppose the floor was not a plane, but bent into the form of a piece of a ball (a piece of a sphere. Suppose Fig 1 was as shown in Fig. 2, so that $ab = ab' = ab'' = ab'''$, and all = 1' 0". In fact, so that the distance from *a*, to any point on $BB'B''B'''$ is the same. Then if $BB'B''B'''$ is one square foot and *A* = 1 m.s.c.p., then one lumen will have been received by $BB'B''B'''$, and if the lamps burns for an hour $BB'B''B'''$ will have had an illumination of 1-foot candle, and will have absorbed one lumen-hour.

Hence, it would appear that the logical way to pay for light would be in lumen-hours. Indirectly this is just what *is* paid for, but as the gas or electric company does not sell gas or energy for lighting only, they sell it in the form of energy and let the public turn killowatt-hours or B. T. U.'s per hour into lumen-hours, or horse-power hours, in whatever way it pleases. We, however, are on the illumination side of the fence, and, therefore, have to do the calculations in lumens, lumen-hours and foot-candles. Comparatively few have realized this necessity. But to realize it, is as foolish as a grocer trying to sell pork and beans by the B. T. U. It can be done, but it won't help him any. The physician measures food by its B. T. U. value to the human system, because he is on that side, whereas the grocer sells food by the pound because he is on the grocer's side of the fence.

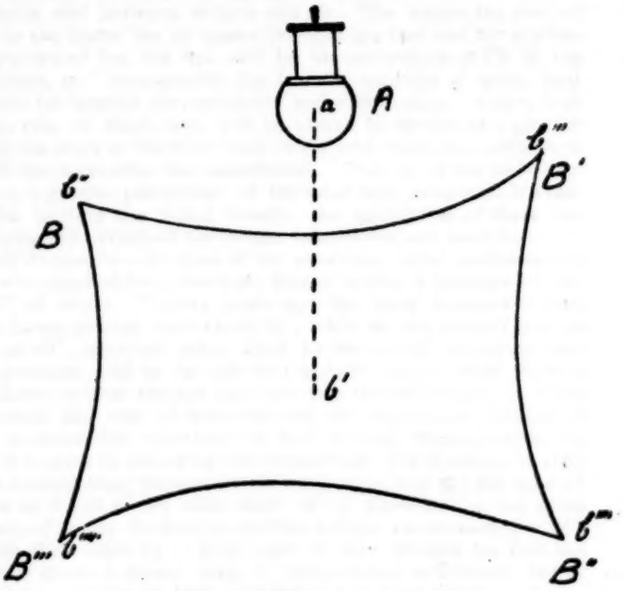

Fig. 2.

It now becomes a simple matter to compare any two lamps. Take for example, a small upright gas lamp, such as is designed Lamp X, on page 322 of the A. G. I. 1912 Proceedings, in "The Photometry of Incandescent Gas Lamps," by Mr. C. O. Bond. It was found to give the following results with water gas of 0.717 s.g. and 632 B. T. U.'s per cubic foot:

Pressure.	Consumption	M. S. C. P.	Lumens per B. T. U. per hour.
2.5"	1.21	27.0	0.443

From "Engineering Data" of the General Electric Company, April 1, 1915, a 40-watt straight side 105-125-volt multiple tungsten lamp is rated as having an efficiency of 0.76 spherical candle-power per watt, which gives a spherical candle-power of 30.4 m.s.c.p. (somewhat higher than our small gas lamp, but sufficiently near for a rough comparison). This 40-watt lamp is said to have a flux of 381 lumens, and an efficiency of 9.52 lumens per watt. In the case of the gas lamp, 1.21 cubic feet being consumed in one hour, and there being 632 B. T. U.'s to 1 cubic foot, 632 x 1.21, or 764.72 B. T. U. have been consumed to produce 27.0 m.s.c p.; or, multiplying the lumens per B. T. U. per hour (0.443) by the B. T. U. consumed in an hour (764.72), we get 338.77 lumens for the gas lamp, as against 381 lumens for the electric lamp of slightly greater m.s.c.p.

Now, assuming the cost of gas to be $1 per 1,000 cubic feet, and electrical energy to cost $0.10 per kilowatt hour, the gas consumed in one hour will be 0.121 of a cent (for 336.77 lumens); and for the electric lamp, 40 watts for one hour will cost 0.4 of a cent; or assuming straight proportions:

$$338.77 : 0.121 = 381 ; X$$

Whence, $$X = \frac{0.121 \times 381}{338.77} = 0.136 \text{ of a cent};$$

or, in other words, for the same light flux, in lumens, the gas costs 0.136 of a cent and the electricity 0.4 of a cent. That is to say, the electrical quantity of light flux costs $\frac{0.4}{0.136}$ or 2.94 times the cost of the gas quantity of light flux; or in round numbers, the electric light costs three times the gas light.

If other comparisons be figured on the same basis—namely the light flux in lumens given out by the watts or B. T. U.'s per hour expenditure—a just comparison is obtainable. It gives something definite—something tangible, and to the writer it would seem one of the very few ways of making such comparisons.

It may be of interest to point out that although gas light output is not exactly proportional to the B. T. U. input, neither is electric

1. The mean spherical c. p. is the mean of the intensity of light radiating in all directions.

2. This explanation is, of course, correct only if the intensity is equal in all directions, i. e., if the distribution curve is a circle with its centre at the origin.

light output proportional to the input in kilowatt-hours; as may be seen by reference to Fig. 3, which shows characteristic curves for

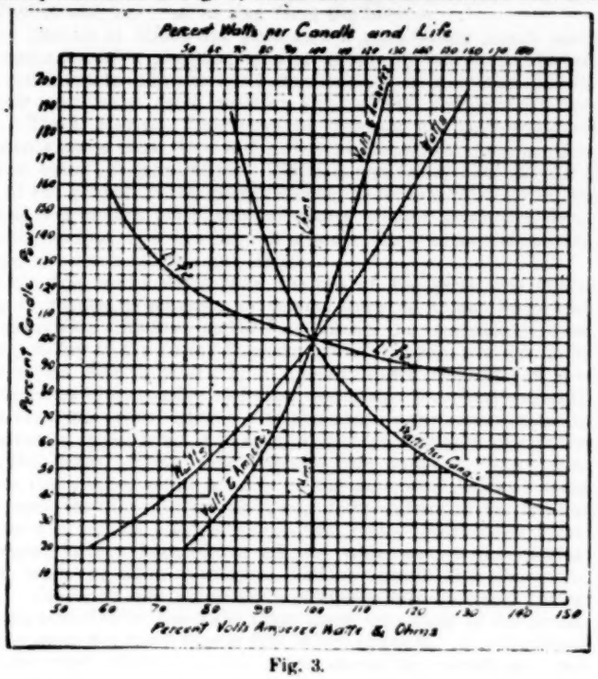

Fig. 3.

carbon filament electric lamps. For a given percentage rise above, or fall below, 100% in electrical potential, the gain or loss in light is not an equal percentage. This is shown by the curves.

The writer is indebted to Mr. R. ff. Pierce for going over the above article and for his suggestions.

Benzol Production in Coke Plants.

In response to the demand for high explosives, a new industry, the recovery of benzol and toluol, suddenly sprang into existence in the United States in 1915. Before the European war the demand in the United States for these products was so small that but one company engaged in coke making sought to recover them on a large scale. Late in 1914 the price of benzol, and toluol rose to such a point that other companies built plants to recover these oils from the gas, and by the end of 1915 there were 19 new plants for benzol recovery in operation and others in course of erection.

Reports to United States Geological Survey, by by-product coke plants, indicate that the output of benzol and other light oils in 1915 amounted to 13,942,763 gallons, in connection with which there were produced 761,256 pounds of naphthaline. Several of the plants are not equipped to separate the different oils found, and 7,322,670 gallons, more than half of the total output, was crude benzol and light oil, and was shipped to refineries connected with powder works and other chemical industries. In the 6,620,093 gallons of oils refined at the place of recovery, there were 4,833,939 gallons of 100% benzol, 1,315,727 gallons of toluol, and 470,425 gallons of solvent naphtha. Thirty-one coke-making establishments with 4,933 by-product ovens contributed to this total, and it is estimated that between 8,000,000 and 9,000,000 tons of coal were carbonized to furnish the gas from which the oils were recovered. The annual capacity of the benzol-recovery plants now in operation is estimated at over 20,000,000 gallons, and with the completion of plants now building will probably exceed 22,000,000 gallons. The value of these products is indicated by the prices currently reported during the year. Benzol, normally selling for 20 cents or less a gallon, in September brought as high as $1.25 for immediate shipment and 65 cents on contract; toluol, with a normal price of 25 cents, was sold for as much as $6 a gallon for immediate delivery and was contracted for at $4.25 per gallon.

Benzol is an excellent motor fuel, but the United States with an output of gasoline estimated in 1914 at 30 to 50 million barrels (1,500,000,000 to 2,500,000,000 gallons), is no need of additional supplies for this purpose. There is, however, in normal times a large use for dyes and chemicals, such as carbolic acid, which depend upon benzol and toluol for raw material and which have in the past been largely imported from Germany either as finished or as intermediate products.

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History of the Development of Water Gas.

Paper by O. B. Evans, to the International Gas Congress.

Principles of Water Gas Operation, Improvements in Design and in Operation.

An outline of some of the principles of water gas operation, and a description of some of the improvements made in operation and design, may help determine why any type of apparatus should or should not be a success.

Oil Treatment.—During the early days of the Lowe system, while the generator-retort processes were at the height of their popularity, there was much difference of opinion as to the proper method of handling oil for gas making. The merit claimed for the retort process was its uniform treatment of oil, every particle being subjected to approximately the same conditions. In the original Lowe process, with its blows and runs of from 20 to 30 minutes, the variation in temperature of the fixing vessels between the beginning and end of a run, was so great that if the temperature at the end of the run was sufficient for the proper fixing of the oil, it must at the beginning have been too great. That this criticism was well founded is evidenced by the fact that in at least one plant using the Lowe system, it was found necessary regularly to shut down the set after every two or three runs, and to remove lampblack from the connections.

The theory of equal treatment of each particle of oil is still believed to be sound; the absence of blue gas during fixing, however, is known to be a serieus defect. The great variation in temperatures of the Lowe process was overcome by increasing the quantity of checkerbrick, so as to introduce a "fly-wheel" effect, and by shortening the lengths of blow and run. While the variation in temperature of the checkerbrick in the top of the carbureter is somewhat great even in a modern Lowe set, the calculated average temperature change of the entire mass of brick in the carbureter and superheater between the beginning and end of a run, is only about 45°. Measurements by the pyrometer indicate that the maximum variation in the superheater is probably not over 20°.

The old theory of proper oil treatment was to vaporize it at a low temperature, and increase its temperature gradually during its passage through the apparatus; in other words, the Lowe set was operated with a cold carbureter and a hot superheater. It is now believed that the decomposition of an oil is a function both of the temperature of the fixing surface, and of the time during which the oil is in contact with the surface. That is, the result obtained by a given temperature and time of contact, might also be produced by a higher temperature and a shorter time of contact, or a lower temperature and a longer time. Since both the temperature of the fixing vessels and the quantity of gas made are a maximum at the beginning of a run and a minimum at the end, the minimum time of contact between gas and checkerbrick takes place at the maximum temperature. For this reason it is possible that a slight lowering of the temperature as the run progresses may actually tend to produce a more uniform treatment of oil than were the temperature to remain unchanged. The present tendency is to carry a high temperature in the carbureter and low temperature in the superheater; the curbureter service to vaporize the oil, while most of the fixing takes place at a lower temperature in the superheater. The high heat in the carbureter is necessitated by the short time allowed for vaporizing the oil, and while the oil may come in contact with very hot bricks, it probably does not reach anywhere near their temperature.

To effect the rapid vaporization of oil at low temperatures it was customary at one time to use iron bars for the top row of the carbureter checkers. This construction was abandoned because of the rapid loss of iron by oxidation, but within the last few years the practice was resumed in an experimental way, the bars protected from oxidation by allowing the combustion of the blast gas from the generator to take place in the firebrick checkers, the iron bars being heated by the hot gases after combustion was practically completed. It failed to show any improvement in results over the ordinary methods.

The method of introducing oil has been the subject of much thought and experiment. In the Granger-Collins apparatus it was sprayed under a pressure of 500 pounds per square inch; but pressures have been continually reduced, so that carried at the pumps now rarely exceeds 40 pounds. It is generally recognized that if oil is introduced into the carbureter as a mist, its distribution may be greatly changed by the entering blue gas; injectors that give a perfect distribution in a motionless atmosphere may give a very

different one in service, because of the currents. It is believed that an oil spray giving a fairly even distribution, and from which the oil issues in streams of sufficient mass to prevent any great change in direction by the flow of gas, will give oil results as good as, if not better than, an injector from which the oil issues as a mist.

For many years it was customary to pre-heat the oil before spraying it into the carbureter, by forcing the oil through a coil of pipes in the standpipe. These oil heaters gave considerable trouble, stopped up with coke from the oil, and apparently had no beneficial effect upon results.

About 20 years ago several new designs of apparatus appeared, the distinctive advantage claimed being based upon the fractional treatment of the oil; generally obtained by introducing the oil at an intermediate point in the height of the superheater, enabling the lighter vapors to separate and immediately ascend, while the heavier, unvaporized portion fell back against the current of ascending blue gas, thus traversing a greater length of fixing chamber. The plausibility of the scheme lay in the inference that these lighter vapors were more easily gasifiable, and would be converted into lampblack if exposed to the same fixing surface as that required for the heavier portions of the oil. Recent experiments seem to show that the value of an oil for gas making purposes depends upon the proportions of the various series of hydrocarbons present in the oil, and that these series exist in the lighter fractions in about the same proportions as in the heavier; that the same heat treatment that gives best results with the light fractions, produces the best results with the heavier. This theory, if confirmed by later investigation, will eliminate future consideration of fractional treatment of oils.

Up-and-Down Runs and Blows.—The introduction of the down run, to heat the bottom of the fuel and permit it to burn during the blast, had several effects. It reduced the labor of cleaning the apparatus, and of returning to the fire the unburned fuel picked out of the ash and clinker. It reduced waste of fuel by consuming in the set the small pieces that ordinarily would go to the ash pile. By making it possible to vary the height of the zone of highest temperature, it allowed better control of clinker and the use of a wide range of fuels. By enabling the temperature of the top of the fire to be varied, the temperatures of the fixing vessels were more easily controlled. It would seem that up and down blasting should have, in general, the same effect as up and down running, but since the travel of the plastic clinker is downward, down blasting probably assists the travel, and may have a tendency to force the plastic material into the passages in the fuel bed and into the previously formed clinker, and thereby produce a mass more impervious to blast; up blasting, on the other hand, would seem to tend to keep the passages open. Whatever may be the reason, down blasting apparently increases the resistance of the fuel bed, and results in a channelling of the fire, with a decrease in the quantity, and injury to the quality, of the gas made.

The chief function of the fuel bed is to decompose the steam, and since decomposition it more complete the hotter the fire, it would seem that the most efficient results should be when carrying maximum temperature; this temperature being limited by the clinkering of the fuel, by the chemical and physical properties of the lining material, and, to some extent, by the desired chemical composition of the generator blast gases. Therefore, in order to depart from this temperature as little as possible, the bed should be worked with a small range in temperature; this necessitates short blows and runs. In the early days of the Lowe process, the blows and runs were of from 20 to 30 minutes. The usual result was that after operating for 10 or 12 hours, the clinker formed was so hard that it took from 4 to 6 hours to remove it. The wide variation in the heat between the beginning and end of a 30-minute run resulted in an excessive production of both tar and lampblack, and the routine work of the gas plant included removing this latter by-product from wash-boxes and mains. As late as 1889 we find presumably well managed plants operating with a blow of 25 minutes, and a run of 15 minutes; whereas, at present, blows of over 3 minutes and runs over 4 minutes are unusual, and occasionally one hears of 1½-minute blows and 2½-minute runs.

With the same purpose in view (that is, to operate at as near a uniform temperature as possible) the runs, instead of being all up or all down, are "split," a certain part of each run being made down. It has been found advantageous to make the first portion of the run up, for if the first portion is made down it may produce upon the fluid clinker the same effect as with the down blasting. Also, by taking the down portion of the run last, a given fire temperature will produce minimum temperature at the grate.

Rate of Blasting.—The sensible and latent combustion heat of the blast gases, when completely utilized, should be just sufficient to maintain the proper temperatures in the carbureter and superheater. Since the vaporization and fixing of 5 gallons of oil per M. will require more heat than 3 gallons, it is evident that if sufficent heat is sent over from the generator for 5 gallons there will be too much for 3 gallons. Numerous experiments have been made upon the effect of velocity upon the reaction between carbon and steam, and between carbon and air. The higher the rate of blast, or the faster the air passes through the fuel bed for a given temperature of fire, the less will be the percentage of CO in the blast gases, and consequently the less the quantity of latent heat available for heating the carbureter and superheater. Again, with a given rate of blast, heat will be stored in the fire at a greater rate at the start of the blow than at the end, while the converse is true in the carbureter and superheater. That is, as the blow progresses, a greater percentage of the total heat generated is available for heating the fixing vessels. An application of these two principles will permit of the proper balance for any condition.

Blast Pressures.—In some of the generator retort processes the blast was supplied by a steam-jet blower, giving a pressure of not over 2" of water. Twenty years ago, the blast pressure carried in the Lowe process was about 18", while at the present it is as great as 40", this limit being fixed by the cost of supplying such high pressures, and by the fact that at high rates of blast there is a tendency to blow the fine fuel over into the carbureter. In order to increase the rate of blast without the expense of increase of blast pressure, the resistance to flow through the apparatus has been decreased by enlarging the connections. For instance, in 1889 the generator blast connection, the stack-valve and the gas take off for an an 8-foot 6" set were each 12" in diameter; in the same size sets of to-day the blast connection and the gas take-off are 16", and the stack-valve 24". High rate of blast through the fuel bed probably gives a deeper zone of temperature sufficiently hot to make gas, resulting in high production and good quality. By increasing the rate of blasting and decreasing the length of blow, the capacity of a given size set has been more than doubled during the past 25 years, giving a decrease in the investment cost of the apparatus per M. and an increase in oil efficiency, high capacities being apparently favorable to good oil results.

Dust Catcher.—Most of the increase in set capacity has been due to an increase in the rate of blasting of the fire, and this has increased the quantity of ash and fine fuel blown out of the generator. Unless provision is made for collecting this material, it enters the carbureter, is deposited on the bricks, and clogs the passages between the checkerbrick, and interferes to such an extent with the proper vaporization of the oil that the apparatus has to be shut down and cleaned. The ability to increase the capacity of a set is, therefore, somewhat dependent upon the quantity of dust that enters the carbureter.

To prevent these solid particles entering the carbureter, a dust catcher has been devised. It is based upon the principle that if the direction of the flow of a gas containing solids is changed, the greater inertia of the solids will cause them to continue to travel in a straight line, and thus drop out of the gas.

Air and Steam Meters and Pyrometers.—One of the greatest strides in the commercial production of water gas is due to the introduction of air and steam meters. Prior to about 1907, air and steam were supplied in a cut-and-try manner, and there were no means of definitely controlling the generation of heat, and its utilization. Measuring devices, with the thermo-electric pyrometer, allow operating conditions to be maintained or changed in a definite way, and have taken the apparatus out of the rule-of-thumb class and made of it a scientific machine.

Mechanical Cleaning of Fires.—Of late years the selection of a suitable fuel has received considerable attention, and much work has been done to overcoming the objectionable features of hand cleaning. The advantage of preventing the accumulation of clinker and thereby securing a fuel bed of uniform condition from hour to hour require no argument. While returning the combustion products to the base of the fire for reduction of temperature, and prevention of clinker, has proved successful in coal gas producers, the reason for its inapplicability to water gas manufacture is evident. As stated above, although it is theoretically possible to make water gas at a temperature of 2,000°, the Bureau of Mines has shown that this is possible only when the time of contact between the steam and the carbon is very long, explaining why, in commercial work, it is necessary to carry a fire temperature much higher than that. In practice, it is believed that water gas cannot be produced satisfactorily in a fuel bed having a maximum temperature much less than 2,800° F. The ideal fuel would be, one having an ash that will not fuse at the highest temperature to which it will be

subjected. Since ideal fuel is not available, the next method of controlling clinker is to use a fuel containing a low-fusing ash, melt the clinker and tap it off as slag from the bottom.

The Bureau of Mines has published a preliminary report upon the operation of a slagging type of producer, but it is believed that considerable difficulty has been met with in later experiments not the least being rapid wearing away of the lining in the slag zone. The United Gas Improvement Company has made some experiments along these lines with a view to adopting a slagging principle to water gas generators. While it was found easy to slag a part of the clinker, there always seemed to be some that could not be kept in a molten state, this refractory clinker gradually accumulating so that in a few days it was necessary to shut down the set and remove it by bars and sledges.

As the fuel works down from the top of the generator to the grate it gradually increases in temperature to a maximum, and then decreases. As soon as the fuel reaches the temperature zone corresponding to the fusing temperature of the ash, and ash melts and remains fluid or plastic in its passage down through the successive zones of increasing and then decreasing temperature, until it reaches the zone having a temperature corresponding to its solidification point, when it hardens, the outer ring adhering to the generator walls. From this it seems that under ordinary conditions the clinker must adhere to the generator walls at some point, and that the higher the fusing temperature of the ash the greater will be this distance above the grate. Anthracite coals, in general, have a high fusing ash, for which reason the sticking on the walls, or collar formation, will be several feet above the grate. Cokes, on the other hand, generally have a lower fusing ash, and adhesion to the walls takes place very close to the grate, in many cases not more than a few inches above it. In selecting a generator fuel, therefore, this point should be considered; the higher the fusing temperature of the ash the higher above the grate will be the zone of sticking, and with nearly all fuels sticking will take place somewhere.

Ordinarily, there is a sharp line of demarcation between the ash and clinker on the grate, and the fuel above it. Since the ash on the grate is generally fused into a solid mass, it follows that the upper portion of the ash line when this transition from a fluid to a solid takes place, must be at a high temperature, therefore, if a mechanical grate is to operate on cold clinker, it must have sufficient power to break up these lumps; if it operates on a thin layer of clinker it must be designed to stand high temperatures, and will in addition probably remove an excessive quantity of good fuel with the clinker. The lack of success of many mechanical grates has probably been due to a failure to recognize these principles.

Exhaust Steam.—The quantity of steam admitted to the generator is from 30 to 35 pounds per 1,000, and represents approximately 4 or 5 pounds of boiler fuel. In order to reduce this item, superheated exhaust steam has been successfully used in several large plants.

Waste Heat Boiler.—The quantity of heat escaping from the superheater stack of a carbureted water gas set amounts to about 35% of the heat of combustion of the fuel. By means of the waste heat boiler the greater part of this heat is now recovered and used in generating steam, thereby materially reducing the cost of manufacture.

Automatic Operation.—The first apparatus for the automatic operation of a water gas set, of which we have information, was designed and constructed by Mr. C. F. Zeek, at Pensacola, Fla.; and described in a paper read by him before the Southern Gas Association in 1915. Briefly, the runs and blows are put on and taken off by clockwork, the power operating the valves being compressed air acting upon a water piston. The apparatus has passed the experimental stage, having been in use for nearly 2 years. It seems that it should be only a comparatively short time before the entire operation of gas-making, from the charging of the fuel to the removal of the ash, will be automatic.

Increase in Efficiencies.—In the early days of the gas business the residuals were a charge rather than a credit. In one of the older works, using the Hanlon-Johnson machines, much of the oil condensed in the drips, and it was customary to run this waste into a canal to the delight of the boat owners, who claimed it stopped leaks. Before very long, however, the practice was declared objectionable, and since the sewer was closed to it, the means employed for its disposal was to burn it, so an old boiler shell was set up in the yard, the tar and drip collected therein, and periodically burned.

At the present day large sums are invested in apparatus for the separation of this once waste material into valuable by-products, many of which have heretofore been obtained only from coal tars. All of the tar and drippage is carefully collected, and manufactured into pitch for roofing, tar for road binders, dust layers, etc., naphthalene, creosote oils, solvent naphtha for solvents, paint thinners, etc., benzene and other members of aromatic series of hydrocarbons. Recently there has been considerable activity in the conversion of water gas tar products into chemicals used in dyeing.

It is stated that to produce a 35-candle power gas in one of the earliest generator-retort processes, required about 10 gallons of gas naphtha and 140 pounds of 72-hour coke per 1,000. In 1889, with the Lowe process, we find generator fuel figures of from 45 to 50 pounds per 1,000, with oil efficiency averaging about 4.75 candles per gallon. In present day operation the yearly figures for a well managed plant will average about 31 pounds of generator fuel per 1,000, with an oil efficiency of from 5.75 to 6.40 candles per gallon.

The quality of the oil supplied varies continually. Refineries are taking increasing quantities of the lighter and more valuable products from the crude oils, leaving less and less in the residual gas oils, so that it is reasonable to suppose that the gas-making quality of the average oil of to-day is lower than that of the past. While oil efficiencies obtained are in general but little, if any, higher than those of, say, 10 years ago, the fact that they remain approximately the same when using an inferior raw material, is possible only by reason of the improvements made in operation and design.

In view of the increases already made in operating efficiencies, it may be well to consider what further possible economies may be expected.

Let us assume that to make 1,000 cubic feet of carbureted gas there is required 750 cubic feet of blue gas (containing 50% of H and 50% CO), and 250 cubic feet of oil gas.

The heat absorbed in the complete decomposing of sufficient steam to make this 750 cubic feet of blue gas will amount to about 70 B. T. U. per cubic foot, or 52,500 B. T. U., equivalent to the combustion of 3.6 pounds of carbon at 100% heat efficiency. The carbon carried away by the CO in the blue gas will amount to 11.9 pounds, and if we assume the latent heat of vaporization of the oil to amount to 0.3 pound of carbon, the minimum quantity of fuel required per 1,000 of carburetted gas, assuming comple recovery of heat and 100% heat efficiency, will amount to 15.8 pounds of carbon. The present actual minimum consumption is about 24 pounds, so that there is a theoretical possible maximum saving of about 8.2 pounds per 1,000.

Most of this 8.2 pounds of carbon is lost as sensible heat in the excess steam, in the blast and in the gas leaving the stack, and by radiation and convection losses. The addition of a waste heat boiler returns heat equivalent to about 4.5 pounds of carbon, but this fuel can properly be credited only to the the cost of the boiler fuel that it replaces. Moreover, the temperature of the gases leaving the boiler is limited by the temperature of the steam carried.

Some 20 or 25 years ago, pre-heating the air and steam by these waste products was given serious thought; the theory was advanced that by pre-heating the steam, the water gas reaction would be accelerated, and the saving in fuel would be greater than that due to the additional heat supplied to the set through superheating. Experiments, however, failed to show any increase in efficiency. The chief objections to superheated steam and air seem to be the added cost of the apparatus, and the possibility that superheating air and steam would increase clinkering troubles. It is believed by some that the latter objection can be overcome, that the operation of the fire at the much higher temperature practicable, combined with increase in rate of blast and decrease in length of blow, would result in a decrease of fuel consumption in excess of that theoretically saved by mere recovery of the waste heat. The immediate prospect of materially decreasing the consumption of generator fuel, except along these lines, does not appear bright; still every year something is added to our stock of knowledge of the fundamentals of water gas manufacture, and it is possible that in the near future methods may be developed whereby a wider range of fuels and cheaper ones can be used, or the consumption of present fuels appreciably reduced.

MR. WILLIAM A. BAEHR, consulting engineer, of Chicago, has been named by the Merchants Power Company, of Memphis, Tenn., as its arbitrator in ascertaining the value of the plant, transmission lines, etc., which are to be taken over by the city. The commissioners of the city will select another, and a third is to be selected by these two. A bond issue of $1,500,000 has been voted for the purchase.

RECOVERY OF AMMONIA FROM WASTE LIQUORS.

E. L. KNOEDLER, in "Journal of Ind. and Eng. Chemistry.

A recent investigation of waste products in the plant of the Welsbach Company brought to light a solution containing about 1% of ammonia, which was being discharged into the sewer. It consisted of a mixture of three ammoniacal solutions, containing the following percentages of free and combined ammonia:

No.	Free NH_3.	Combined NH_3.
1. Solution	3.5	0.17
2. "	0.5	0.025
3. "	0.1	0.005

When run to waste, the mixture approximated 1% free ammonia and 0.05% combined ammonia. The solution was clear, and recovery of the ammonia was found practicable by the usual methods or distillation. The waste liquor was produced by the factory processes at practically a constant rate throughout the working day, and this influenced the decision to recover by means of a continuous still. In the selection of the apparatus, easy and inexpensive maintenance and operation were considered.

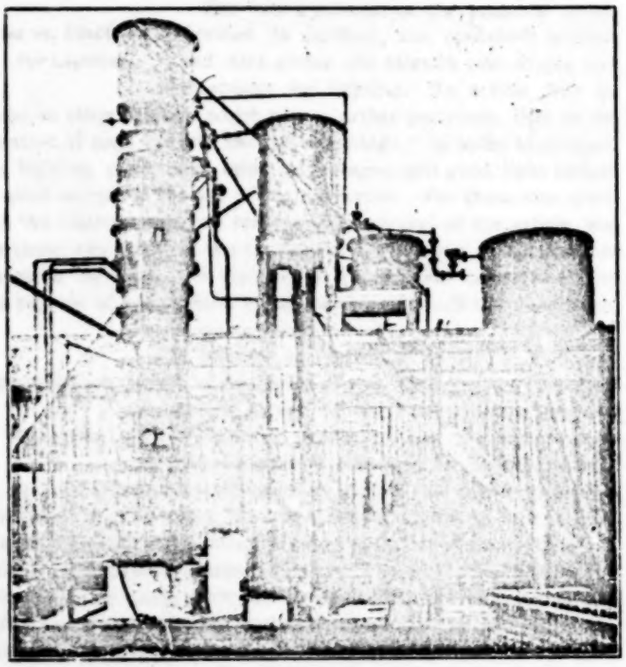


Fig. 1.

With these points in mind, the distilling outfit shown in Fig. 1 was set so that the waste liquor flows by gravity from the factory to an iron tank set in the ground just outside the still house, from which it is pumped to the storage tank above the column of the still. This pumping is the only handling of liquor during the complete cycle of operations—the storage tank supplying the liquid at a constant head at all times, whence it flows by gravity through the washer, the coils of the heat exchanger, the heater and the still—the waste passing around the coils of the heat exchanger and then to the sewer. The ammonia vapors pass through the condenser and into the absorber, from which the freshly distilled ammonia overflows into the storage tank, which is set at such a height that the fresh solution flows by gravity to the factory for use.

Steam for the still is automatically controlled, as is also the lime for release of the fixed ammonia, so that it is necessary for the attendant to look in only once each hour or two, to see that the still is operating satisfactorily. The bulk of the heat in the waste liquor is saved by preheating the crude liquor in a heat exchanger and seal pot—the latter acting also as a constant flow automatic valve for the release of the waste. The consumption of lime is reduced to a minimum by keeping the milk of lime constantly stirred and delivering it in small quantities at frequent and regular intervals. The operation of the still is extremely simple and is as follows, references being to Fig. 2:

The weak liquor is pumped to the storage tank, *A*, by a small steam pump—the exhaust of which is led into the still The liquor flows at a constant rate, down through the washer, *B*, and through the coils of the heat exchanger, *C*, back up through the heater, *D*, where it overflows through the pipe, *E*, into the volatile still, *F*, where the free ammonia is driven off. The liquor then passes out through the pipe, *G*, into the lime leg, *H*, where it meets and is thoroughly mixed with the milk of lime; then it passes back into the fixed still for ammonia, *I*. Here the fixed ammonia is released, and the waste liquor passes down and out around the coils of the heat exchanger by the pipe, *L*, and overflows to the sewer.

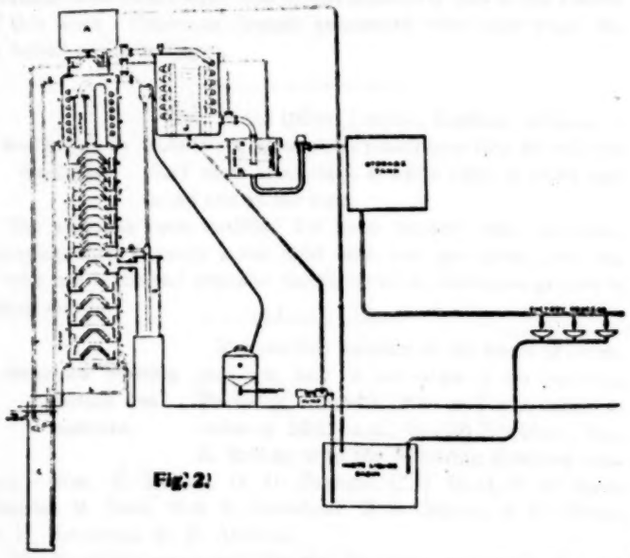


Fig. 2.

The ammonia vapor passes up through the still, bubbling through the down-coming liquors in its passage from one section to the next, and then passes out through the coils in the heater, *D*, and over into the condenser, *J*, by the lead pipe, *M*. Here the water vapors are condensed, and a portion of the ammonia absorbed. The condensate then flows down into the absorber, *K*, where it is kept cool by water flowing through the coil, *N*. Here the balance of the ammonia vapors are absorbed, and the resulting ammonia solution passes over into the storage tank, from which it flows by gravity through lead pipes to the factory where it is used.

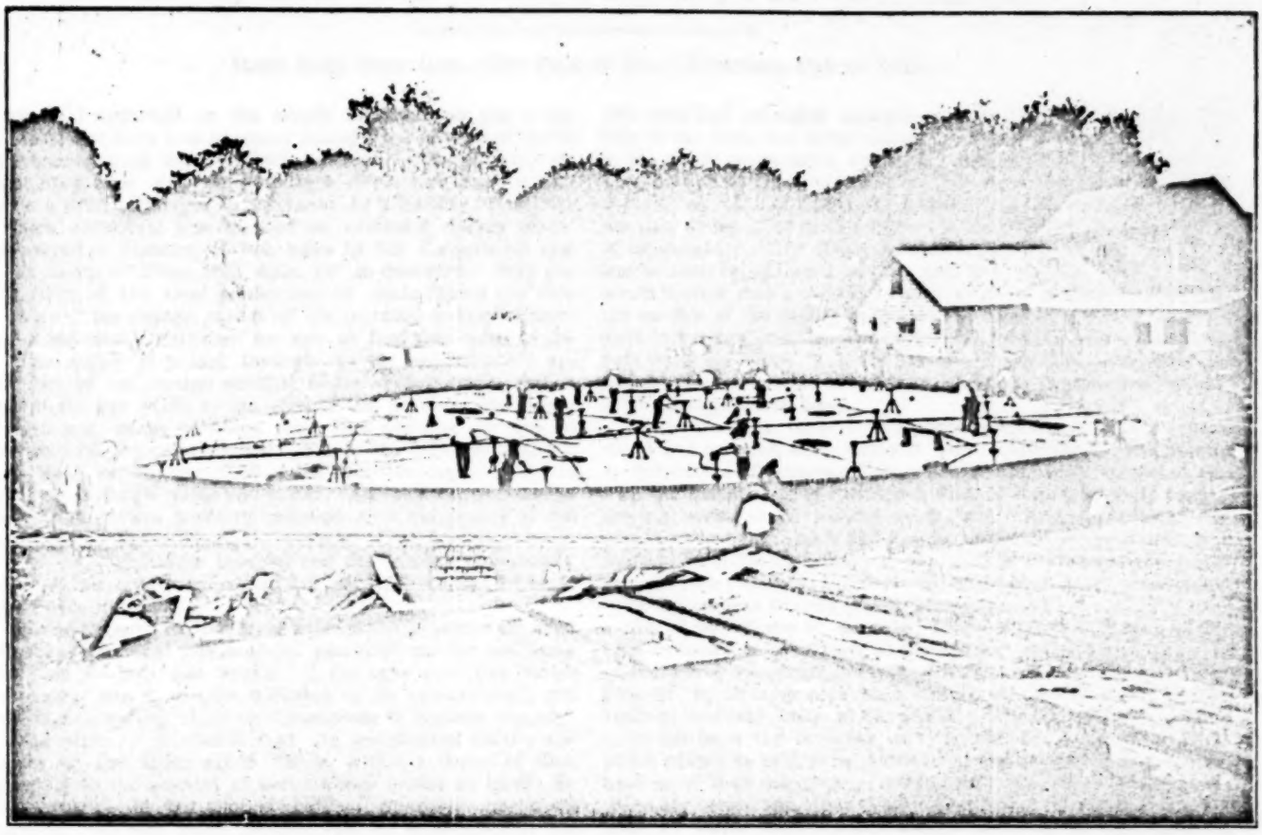
The milk of lime is made up and kept in an iron stirring tank, *O*, where it is continuously agitated by means of compressed air, which also operates the automatic valve, throught which the lime is delivered to the still. The timing of this valve is regulated by a needle valve and by-pass between the top and bottom of a cylinder filled with kerosene, in which a piston descends and ascends. This makes it possible to supply the lime in small quantities and at frequent and regular intervals, making for uniform temperatures and regular operation.

Steam is supplied to the still through an automatic valve, also operated by compressed air. The controller consists of a thermostat, depending for its operation on the expansion or contraction of a liquid, the pressure thus generated serving to operate a small air valve, which controls the compressed air supply to a diaphragm valve, through which steam is served to the still. The thermostat is adjusted to operate at the temperature of the top of the still, and keeps this temperature within the range of 2° F. of the predetermined point. The concentrate runs about 28% NH_3 at all times and is diluted to the desired degree as used.

The cost of operation per 10-hour day is approximately as follows:

Steam, 12,000 pounds.....	$3.00
Labor and supervision.....	1.23
Lime	.20
Repairs, paint, oil, waste, etc.....	.35
Interest and depreciation.....	1.93
	$6.71
Output, 3,000 pounds 26% NH_4OH.	
Cost per 1,000 pounds 26% NH_4OH.....	$2.24

NEW 1,000,000 CUBIC FOOT HOLDER AT FLUSHING, L. I.



Lowering the bottom of the Holder, September 17, 1915.

The condition of the gas supply at Flushing, L. I., has improved greatly with the addition of a new 1,000,000 cubic foot holder erected for the New York and Queens Gas Company, by Messrs. Bartlett, Hayward & Co. The following data was obtained through the courtesy of Mr. M. H. Spear, Secretary and General Manager of the property.

The holder which has 3 lifts, is 123 feet in diameter and 126 feet in height. It is fitted with three 24" stand pipes and an oil skimmer. The gas is fed to the town through two Connelly Balance Governors.

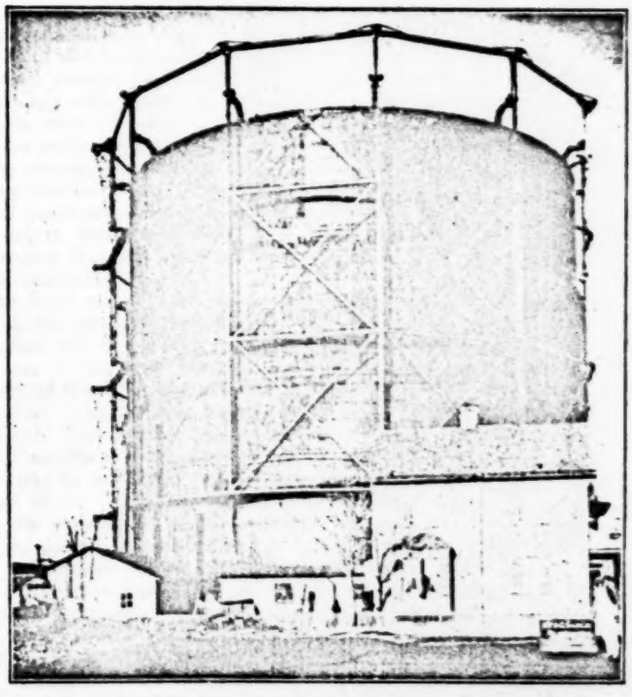
Prior to its final acceptance, the holder was cleared with rust removing distillate, and painted with two coats of red lead and a finishing coat.

The work was started on September 1, 1915, and on September 17th the bottom was lowered as shown in illustration. The holder was put in commission on December 18, 1915.

The New York and Queens Gas Company supplies a rapidly growing community, which includes Flushing, Bayside, College Point and Whitestone, L. I., all within the limits of the City of New York.

Flushing does not include much marsh land, kept damp by the tides, as its name might indicate, and although it has a fine harbor its shipping does not equal that of Flushing, Holland. In population, however, it has outstripped its foreign progenitor. It is a very old Dutch settlement, and has more varieties of trees than any city along our coast.

It is principally a place of homes and commuters, although in the College Point section there are a number of factories.



The new Flushing Holder put in use December 18, 1915.

Telephone - John, 2996.

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CHARLES H. WADELTON, Secretary and Manager

NEW YORK, MONDAY, JANUARY 31, 1916.

Consolidated Gas Company, Annual Report.

The striking feature of the annual report of our largest gas company is the loss of output of over 4 per cent. The reasons for this loss as set forth in the report, which will be found on other pages, indicate very clearly what a vital influence the lighting business has upon sales.

In order to maintain gas sales, the lighting end must be held, as there is no other field *immediately* available which will fill the gap.

Gas vs. Electricity for Lighting.

For over a generation the technical press, devoted to lighting, has contained articles and data giving the relative cost of gas and electricity for lighting. An article will be found in other columns which gives further assurance, that on the question of cost, gas still has the advantage. In order to prosper, gas lighting must have other advantages, and good light backed by good service is the one of main reliance. For those who question the relative costs, we recommend a perusal of the article, and for those who question the availability of gas as a competitor, we commend to them the reports of illumination committees and the reports of competition companies whose bonds are rated high.

Development of Water Gas.

The treatise on Water Gas by Mr. O. E. Evans, which is completed in this issue, gives a very comprehensive survey of the fundamentals covering this method of producing gas. On these fundamentals, prophecies may well be based, and it is to be noted that he confined that portion to rather indefinite promises. He says that "it seems that it should be only a comparatively short time before the entire operation of gas-making.... will be automatic." History does not lead us to any such conclusions, and we fancy with the demand for coke and for oil will cause the supercession of water gas apparatus by *automatic* coal gas outfits rather than those embodying these features in the Lowe process. The labor problem is the best feature of water gas operation, and with the modern accessories of steam and air meters and pyrometers, gas can be made of uniform quality and at a cost which is not excessive. Future improvements will be in operating intelligence rather than in mechanical substitutes.

Gas Meeters, New York Section January Meeting.

New York gas men held another informal meeting at Scheffel Hall, Third avenue and 17th street, on the evening of Jan. 27, when the New York Gas Meeters got together.

The dinner was notable for the democratic atmosphere, which was aided by talent of like order.

There were no speeches even though such capable talkers were present as Messrs. J. P. Conroy, G. E. Smith, J. E. Bullard and H. D. Gillingham.

A special feature of the meeting was a lengthy description aided by moving pictures of the manufacture of Wrought Iron Pipe. This subject is one which can be illustrated in this way, to advantage, as only the noise was lacking to complete the spectacle. This, however, was made up in part by some of the diners. The layout of the plant, the construction of the furnace and the mechanical apparatus, were first shown, being followed by views of each of the operations, leading up to the weighing, testing and inspection of the product. Much stress was laid on the higher labor cost, of wrought iron versus steel, and of the superiorty due to the results of this work. Chairman Chapple announced that there would be a ladies' night in March.

Red Lights on Go-Carts.

The Home Office, London, England, includes a rule in its latest order prescribing that all vehicles shall show after dark a white light in front and a red one at the rear.

The rule has been modified for hand pushed baby carriages, allowing them to carry a red light only, and specifying that the "rear end is the end opposite the direction in which the go-cart is being moved."

Directors' Meeting American Gas Institute.

The monthly meeting of the Board of Directors was held in the rooms of the Institute, Thursday, January 13th, and was called to order at 10:15 A.M., by the President, Wm. E. McKay, with the following directors present: Wm. E. McKay, D. D. Barnum, C. O. Bond, R. W. Bush, Charles M. Cohn, Geo. B. Cortelyou, B. F. Cresson, A. H. Elliott, C. H. Nettleton, W. R. Addicks.

The President announced that the Secretary was detained at his home by illness, and presented a communication from him concerning the publication of the Proceedings of the International Gas Congress, in which the Secretary stated that owing to the unexpected expense of publishing the papers presented to the Congress in advance paper form, the advance subscriptions were not sufficient to cover the entire expense, and he asked that the Institute finance the sum of two or three hundred dollars required to complete the amount, and after discussion, a motion was made and carried that the necessary sum be provided.

The President reported that Mr. Edward G. Cowdery had consented to act as Chairman of the Committee on Arrangements for the next annual meeting in Chicago.

The matter of increasing the office force was, after considerable discussion, referred to the next meeting of the Board, at which time the matter of the finances of the Institute is also to be considered.

A communication was received from the Association of Gas Engineers in Holland expressing regrets that they were not invited to participate in the International Gas Congress.

An invitation from the President of the Illinois Gas Association was received, inviting the Board to hold its March meeting in Chicago at the time of the Illinois Gas Association meeting.

A communication from Mr. J. D. von Maur, and a copy of correspondence between Mr. von Maur, Mr. O. H. Fogg and Mr. W. R. Addicks in relation to mis-statements appearing in the press, and in publications such as "Household Discoveries" and "Mrs. Curtiss' Cook Book'" was received. It was decided to appoint a Committee on Mis-Information.

The President reported that the Committee on Consumers' Meters hand been definitely formed with Mr. W. K. Harrington, Chairman, S. K. Campbell, W. A. Castor, W. D. Kelly, H. A. Norton, C. E. Reinicker, and F. C. Shepard.

SPECIAL ENGLISH CORRESPONDENCE.

Monthly Letter From Norton H. Humphrys, Salisbury, England.

MORE COKE OVEN GAS.—THE FILM OF OIL.—EXTENDED USE OF COKE.

Last month I remarked on the supply of coke oven gas to the city of Leeds, and have now to report that another important north country manufacturing town,—Middlesborough,—has been entirely dependent upon coke ovens as the source of the public gas supply for nearly a year. The gas is produced by a battery of 46 Otto ovens, which constitute a portion of an extensive coking plant, and is conveyed a distance of two miles to the Corporation Gas Works, by means of a cast iron main, 20" in diameter. Only the richer portion of the total production, as made during the first twelve hours of the charge, is sent off the premises in this manner, and the remainder is retained for use as fuel for heating the ovens. The supply is passed through the tar and ammonia extractors, but is not further purified at the coking works, and is delivered at the gas works at the inlet to the purifiers, the subsequent treatment being identical with that accorded to gas as manufactured in the retort house. The price, delivered into the receiving main, is 4d. per 1000 cubic feet the candle power is about 13, the calorific value 550 B.T.U. An important feature is that the consumers are perfectly satisfied with the quality of the gas, as proved by the indisputable evidence of the complaint book. There is no naphthalene trouble, and the sulphur compounds, other than sulphuretted hydrogen, are not appreciably different from the former supply.

The interesting part of this transaction is the evidence afforded by it, to the effect that the modern coke oven can far and away undersell the modern gas works. If the coke oven gas mains were extended into a district occupied by an non-statutory gas company, and therefore under no restrictions as regards the matter of competition, it is evident that the commercial failure and bankruptcy of the latter would follow, within a period of time corresponding to the amount of accumulated profits on hand. No modern resources in the way of vertical retorts or machinery could save it. We may safely assume that the proprietors of the coke ovens are not out to sell gas on unprofitable terms. But the gas committee of the Middlesborough corporation find that they are saving a large amount of money, by buying their gas ready made, and allowing their manufacturing plant, which is of ample size as compared with the requirements of the districts, to stand idle. The cost of the purified gas, as delivered into the holder, is stated to be less than half that of coal gas at present prices of coal and other necessaries, viz. 8d per 1000 cubic feet as against 1/8d.

The coke oven system of gas-making also offers the important advantage of meeting the present scarcity of labor. When both the coal and the resulting coke are handled in large parcels by means of machinery, the man with the shovel is not greatly in request. One would like to know more about the capital outlay and working expenses per 1000 cubic feet of gas made, and other circumstances affecting the selling price of the gas. They are, of course, dependent on a good price for the coke at the works, and at the present time, there is a good demand for the liquid residuals. But after allowing for all this, it looks as if the managers of gas works will have to go to the coke ovens, in order to learn how to make cheap gas.

I have recently directed attention to the advantage of using a thin film of oil on the surface of ammoniacal liquor contained in storage tanks, as a preventative of loss of ammonia by evaporation, and now mention the adoption of a similar precaution for another purpose at the gas works, and that is in connection with gas holder tanks. In this instance, some care appears to be necessary in the way of selecting an oil that is neutral to coal and mixed gases, not absorbing any appreciable quantity of hydrocarbons from the gas, on the one hand, or likely to alter in constitution, in the course of time, by the gradual evaporation of the more volatile components, on the other. It is not clear if the advantages secured by preventing the prolonged contact of the gas with water inside the gas holder, such as obtains under existing circumstances, are represented by the distribution of a drier gas to the district, or whether the oil acts as an absorbent of clots of naphthalene that are deposited from the gas in cold weather, and re-absorbed and carried forward into the district, whenever there is a substantial increase in the temperature of the atmosphere. That it is quite possible for some action of this sort to take place, will be admitted by all who have had extended experience with gas holders, more especially if the tanks are waterlogged, that is, if the natural water line in the soil is appreciably above the bottom of the tank, with the consequence that the inlet and outlet pipes pass through several feet run of cold and damp soil, which acts as an effective cooler of the gas, under some circumstances to the extent of several degrees of temperature. The effects of such a sudden chill, as regards the less volatile constituents of the gas, are obvious. From this it would appear that a chemical examination of samples drawn from the surface of the liquid, inside the gas holder, would be likely to yield interesting results. As regards drier gas, M. Bremond pointed out, many years ago, that dry gas would not deposit naphthalene, and proposed a scheme for drying it, before distribution, by passing it through quick lime.

Two important facts in relation to deposits of naphthalene in mains and services, have recently been established. The number or percentage of complaints from consumers does not synchoronize with the quantity of naphthalene that is found, by daily tests at the gas works, to be present in the gas. And at the lower temperatures to which gas is likely to be subjected, in the course of its journey from the gas-holder to the inlet of the consumer's meter, the carrying power, in respect to naphthalene, is small, as compared with the same at slightly higher temperatures.

One of the effects of the war, which is likely to have a permanent influence on the future of the gas industry, is that, on account of the scarce and unreliable supply of coal, keen attention has been directed, by all large consumers of fuel, to the utilization of other kinds of material, coke in particular. And the result of such inquiry has been the bringing into prominence certain advantages which cannot be said to be previously entirely unknown, but rather have never been adequately recognized. Also, in view of the demand for benzol and other liquid derivatives of carbonization, the folly of worse that wasting useful products of this character, by the consumption of virgin coal as fuel, has become very prominent. Hygienic and sanitary authorities have been talking for years about the loss of these valuable commodities, and the consequent pollution of the atmosphere, which is such an objection and injury to the public health in all our large towns. But, so far, arguments of this nature have not received the general attention that their importance would warrant. Questions relating to fuel economy, smoke abatement, etc., have been looked upon by the public as among the dreams of scientific cranks, rather than a sound business proposition, and this attitude has been reflected by the supineness of the government in respect to such an important national question, even at the present time, which is a marked contrast to the energy with which gas undertakings have been encouraged to increase their output of liquid products—a case of counting up the coppers while the bank notes are being blown out of the window.

The extensive erection of coke ovens, during the last few years, means that more coke is being consumed, and that a larger number of practical men are becoming familiar with the proper ways of using it, and its advantages as compared with coal. One of the results that will follow will be the discovery of new and additional applications for it.

The chief causes that up to the present time have militated against the extended use of coke, are that the proportion of ash is higher, also the content of moisture, in respect to which a liberal use of the hose pipe at some gas works, to an extent that practically means adulteration of the coke with water, is partly responsible. Coke will never have a fair chance, in competition with coal, until it is supplied in a similar condition, as regards percentage of moisture, which means that the present barbarous method of cooling by douching with a large excess of water, must be replaced by a "dry" smothering process. These causes, together with the absence of volatile constituents, result in an increased igniting point. Late ignition is a serious difficulty, when coke is used in furnaces of the traveling grate type. And troubles of this nature have been sufficient, in the views of practical men, to offset the advantages of smoke prevention, the absence of loss of heat corresponding to that absorbed and rendered latent by doing the work of gasifying and decomposing the volatile constituents of coal, and the loss of heat represented by the escape of incomplete products of combustion by way of the chimney. The increased

labor does not encourage the furnace-man to make the best of the coke, even if he gives it a fair chance. The late ignition has been met by the addition of a storage hopper to the front of the boiler furnace, that at the same acts as a miniature gas producer, and secures the delivery of the fuel, at the gate of the furnace, in an incandescent condition. The gases from the hopper pass into the furnace, and are utilized. This arrangement is stated to be in use, with satisfactory results, at several electric works in Germany. In Sweden, coke has been extensively used, mixed with coal, as a fuel for driving railway locomotives. It is found more satisfactory for this purpose in summer, than in winter, the explanation given being to the effect that during cold weather the moisture is higher. It was found desirable to discontinue the use of coke during the Christmas holidays, when the traffic was greater than usual. The cause of this difficulty, and also the remedy, will be evident from the preceeding remarks.

The difficulties in connection with the supply of coal, and the scarcity of labor, which were the cause of much anxiety to managers of gas works during the winter of 1914-5, have been greatly ameliorated in England, although they have reached a very serious position on the continent, especially in France. The Christmas season of 1915-6 has passed, without any serious difficulty or shortage in supply of gas. The railway companies have adjusted their arrangements to meet the altered conditions, and there has not been so much material carried, or Government employment of labor, since the extensive temporary strictures necessary for the accommodation of our largely increased military service have been completed. The more pressing troubles, this year, have been due to the delay or the non-completion of contracts in connection with retort house renewals or extensions on account of the large drafts made by the government on all classes of constructional skilled labor. The glut of crude tar, and consequent difficulty of preventing overflow of the tar well, seems to have passed away, but there is considerable trouble as regards the working up of ammoniacal liquor, on account of the difficulty of obtaining adequate supplies of oil of vitriol. This is also unfortunate in a financial sense, because the prospects in the sulphate of ammonia market are at the moment excellent.

Book Reviews.

Inventions and Patents by Philip E. Edelman.—For inventors, investors or manufacturers and the layman. 290 pages. Published by D. Van Nostrand Company, and for sale by THE AMERICAN GAS LIGHT JOURNAL. Price $1.50.

A very readable description of a very dry topic is presented by a man who has "lived" some of the things he writes of.

The author goes way back to the middle ages for his historical beginnings, but he passes through the intervening centuries at about the same pace that Patents and Inventions have travelled.

The Patent situation is analyzed from sixteen different angles, and beginning with the procedure to obtain one and then how to protect it after you get it. Under the title of Attorneys he explains that even the register of the Supt. of Documents contains names "which ought not to be there."

Under the Germs of Invention the various methods and occasions for inventions are discussed, and the fact that things are often discovered accidentally, is illustrated by the case of the gas mantle. "Welsbach was engaged in experiments with certain rare earths when he noticed the peculiar incandesence of certain materials when held in the flame of a Bunsen burner. His inventive mind led him to further experiments and suggested the impregnation of fabrics with the incandescent material. The gas mantle was finally evolved out of the mass of his experiments."

The appendix which is by far the largest section of the book, occupies 100 pages, devoted to Digests, Decisions, Forms and general data.

Power for Profit.—Principles governing the use of machinery and labor in modern buildings by Reginald Pelham Bolton.

Fifteen essays on the value of central station service, 200 pages 8 x 11. Published by the author and for sale by AMERICAN GAS LIGHT JOURNAL. Price $2.50.

Central station supply of heat, light and power is rapidly approaching universal use, in urban communities, according to the author who is in position to describe conditions leading up to this prophecy, as he has had occasion to investigate many types of isolated plants and has witnessed the abandonment of many in favor of central station service.

Most central station engineers when attacking a power problem, where an isolated plant is considered, immediately resort to elaborate tabulations of costs which often so befog the issue that the question of "service" becomes a minor instead of a major factor.

This book deals with intangibles and they are many and varied. These are forcibly brought out by covering a different point on every page as a heading printed in red at the upper right hand side of each page. They are most effective as will be seen from these examples:

> Owning and operating machinery is not a direct advantage to real estate.
>
> All mechanical operations involve expenditure of human energy.
>
> The extension of public services always tend towards reduction in their cost.
>
> The investment of capital in machinery is a gamble against future reductions in the commercial value of the product.

There are a few direct references to the use of gas, viz.:

> The utilization economy of a gas heated steam boiler may make it cheaper than coal.
>
> With the use of gas for heating the "wastages" may be greatly reduced.

The author states (p. 87) that gas has a heating value of about 750,000 units per thousand cubic feet. We are glad that he said "about" but would recommend that future editions read, "City gas has a heating value ranging from 500,000 to 650,000 B. T. U.s per thousand cubic feet.

> Refering to steam heating apparatus in modern buildings, "The capital investment is from one dollar and fifty cents to two dollars per square foot of radiating surface.

The book is similar to the oratorical pyrotechnics of some gas men at conventions when they say that "Buildings *should* be piped for gas, because some day the piping will be used."

The author banks on the future and says that because coal will be more expensive in the future and because electric rates *tend* to decrease, the prospective builder should arrange for central station current, even at a higher figure than that which would be obtainable with a private plant.

We would add this quotation: "The truth is not always convincing."

Publications.

[All Publications, Catalogues, etc., mentioned below, are kept in our office for the convenience of our patrons.]

Bureau of Mines, Fifth Annual Report.—The Bureau of Mines of the Department of the Interior is primarily a division of investigation. The personnel numbers over 400 and the annual expenditures are three quarters of a million dollars. The work is divided into seven branches, and the number of subdivisions makes their organization chart look like "Heinze 57 varieties".

The Safety and Rescue work undertaken has a good moral influence and is undoubtedly responsible for some of the safety work being done by individual operators.

The Bureau reports that some $7,800,000 worth of coal was purchased by the Government under its supervision, and further says they are going to do some things, the details of which they modestly withold, that will reduce the cost of heating buildings the country over. They claim to have called attention to the possibilities of the coal tar by-product industry, and perhaps this is where "Dr." Norton got some of his ideas. They investigated the oil industry in California from A to Izard, but just what benefits were derived therefrom the report does not disclose. Reference is made to the report on thorium, about which we are more or less familiar, and if the other reports and investigations are as misleading as this one, we would suggest that their activities be concentrated, rather than further extended.

CONSOLIDATED GAS COMPANY OF NEW YORK.

Annual Report Year Ending December 31, 1915.

CONDENSED STATEMENT OF ASSETS AND LIABILITIES.—DECEMBER 31ST, 1915.

Assets.		*Liabilities.*	
Fixed assets, including land, plant and equipment.	$54,385,149.33	Capital stock	$99,816,500.00
Bonds and stocks of and advances to affiliated companies and other investments	111,061,246.50	Convertible debentures	24,846,647.50
Bonds and mortgages	200,000.00	Accounts payable and accrued charges	3,676,687.19
Cash	2,127,624.99	Stock and bond premiums	13,951,396.99
Accounts receivable	3,492,457.03	Renewal and reserve fund	11,962,590.66
Material and supplies	996,081.29	Profit and loss	18,008,736.80
	$172,262,559.14		$172,262,559.14

The figures indicate that the company's earnings from its gas business during the year amounted to	$2,376,753.40
To which should be added the net earnings of the Astoria Light, Heat and Power Company	1,145,467.11
Making the total net earnings from the company's gas business for the year 1915.	3,522,220.51
This amount is equivalent to 4.39% on the value of the tangible and intangible property employed in the manufacture and distribution of gas sold by the company.	
Dividends were paid during the year on the company's capital stock aggregating 6¾%, and amounting to	6,737,613.75
The dividends and interest received on stocks and bonds owned and advances made to affiliated gas and electric companies, amounted to	6,700,383.08
The interest, paid during the year on funded and other debt, amounted to	1,019,745.66
Surplus	1,765,244.18

The gas sales of the Consolidated Gas Company fell off during the year 1915, as compared to 1914, 829,075,400 cubic feet, or 5.02%.

Its gas sales, and those of its affiliated gas companies in the Borough of Manhattan, fell off during the year 1,230,034,900 cubic feet, or 5.38%.

In the Borough of the Bronx the decrease in the gas sales amounted to only 29,803,600 cubic feet, or 0.70%.

In Westchester County and in the Borough of Queens, both of which are growing territories, the sales of gas increased during the year 46,508,502 cubic feet, or 1.98%.

The combined sales of gas of the Consolidated Gas Company and its affiliated gas campanies in the Boroughs of Manhattan, the Bronx and Queens and Westchester County, amounted to 1,213,329,998 cubic feet less than in 1914, a loss of 4.12%.

For the purpose of ascertaining the real cause for the abnormal decrease in the consumption of gas in the Borough of Manhattan, comparisons have been made between the variations in the amount of gas, consumed in 1914 and 1915 in all classes of establishments, including dwellings, apartment houses, stores of various kinds, factories, hotels and restaurants. These indicate that, except in the case of restaurants (which show an increase in gas consumption), the percentage of decrease in dwellings and apartments as well as in all classes of business has varied within a comparatively narrow margin between 2.50 and 9.63%. Five thousand prepayment meter accounts, for example, show an average decrease of 3.65%, while one thousand miscellaneous stores show an average decrease of 6.49%. Five hundred grocery stores show an average decrease in gas consumption in 1915, as compared with 1914, of 9.63%.

Among the reasons assigned for the result shown is the effect of the European war upon large and small manufacturing concerns, which are dependent on Europe for their raw material, and have in consequence greatly reduced their output, resulting in a decrease in gas consumption; the growing popularity of moving picture theatres, which operates to decrease the domestic consumption of gas for illuminating purposes; the ever increasing use of electricity for such purposes as well as the growth of the use of small electric appliances, which supplant the gas consuming ones heretofore used; the weather conditions during the months of January, February, March, November and December, 1915, which were not favorable to the normal consumption of gas in those months; the policy of the Department of Water Supply, Gas and Electricity, which has led to the displacing of a very large number of gas street lamps and the substitution therefor of electric lights; the practice of greater economy in the use of gas for illumination as well as for domestic purposes; the growing popularity and use of incandescent gas mantles, which, compared with the old time flat flame burners, combine greater illumination with diminished gas consumption.

During the year the Consolidated Gas Company and its affiliated gas companies installed 187,851 appliances and there were surrendered to the company 97,455, a net increase of 90,396 in the number of appliances in use, which had been installed by the companies, as against a net increase in the previous year of 61,570 appliances. The net increase in 1915 included 1,582 hotel and restaurant appliances and 3,496 industrial appliances.

On December 31, 1915, the Consolidated Gas Company and its affiliated Gas Companies had under rental contracts 428,983 cooking appliances of various types, an increase of 19,920 over the number, installed on December 31, 1914.

Among the larger hotels and industrial installations made during the year may be mentioned those at the Hotels McAlpin, Holland, Majestic, Martha Washington, Imperial, Wallick, Walcott, Renaissance and Chelsea; the Fordham, Bellevue, New York, Harlem and New York Foundling Hospitals. Among the restaurants equipped with gas kitchens were Murray's, Archambault's, Gardner's, The Savarin, Healey's and the Hofbrau Haus. The list also includes the Bankers' Club and the Merchants' Dining Rooms.

Among the purposes for which industrial appliances were installed are included japanning automobile bodies; sterilizing milk bottles; lacquering display fixtures; firing china; heating doll molds; heating presses; reducing radium ore; supplying heat for the manufacture of paint and also for the treatment of automobile springs; heating oils for compounding; applying heat to schrapnel shells; supplying steam for corrugated paper; dressing belts; treating with heat certain parts used in the making up of electrical novelties; manufacture of dies: producing steam for heating acid baths; the manufacture of drugs, face creams, soaps and toilet preparations; supplying steam for cloth sponging cylinders, the manufacture of millinery supplies, heating various oil baths, the manufacture of ladies' hats, the wholesale baking of veal-loaves and also bread, and the smoking and curing of hams and bacon.

Last fall the gas company inaugurated another lamp campaign to promote the "C.E.Z." incandescent gas lamp. This lamp, simple in construction, is equipped with three small mantles of great durability, and is the latest development in the art of incandescent gas lighting. It diffuses a soft, mellow light of high illuminating value. Its merits have evidently been recognized by the public, as over 100,000 have been sold since the campaign started. In the campaign of two years ago more than 91,000 incandescent gas lamps were sold.

The installation of two 72" gas mains in the new Astoria Tunnel, between Astoria and the Bronx, was finished during the year and the transmission of gas through these mains began October 1, 1915. Their installation marks the completion of comprehensive plans, whereby the gas distributing systems in the Boroughs of Manhattan, the Bronx and Queens are connected in a manner which insures an uninterrupted supply of gas in the three boroughs, supplied by the Consolidated Gas Company and its affiliated gas companies, thus conserving permanently the safety and convenience of the public.

THE LIGHT-REFLECTING VALUES OF PAINTS.

[From paper by H. A. GARDNER, to the Franklin Institute.]

The attention of engineers is constantly called to the relative value of different types of artificial illuminants for interior spaces, but very little thought has been given to the light-reflecting power of the interior surfaces where the illuminants are used. That the surface is quite as important a factor as the type of illuminant is indicated by the tests herein described, where the illumination of an interior lighted with a tungsten lamp varied from 12% to 67% when different surface colors were used.

Although considerable work has been done on the light-reflecting power of wall paper, the constantly-decreasing tendency to use paper because of its unsanitary properties, and the steadily increasing use of oil paints, especially in hospitals and public buildings, have necessitated a reconsideration of the problem, since different methods of determination would be required in many cases for two such different substances as paper and paint.

A search of the literature on illumination has produced one article that gives a series of photometric measurements on the reflective value of paints. It is by Louis Bell, who notes that traces of carbon in a paint (gray) or dust of a painted surface immensely decrease illuminating values. He advocates the use of light-colored oil paints on account of their washability. Some of his readings are given below. The composition of the paints is not given, and the colors are only described by terms.

Color	Kind of paint	Per cent. reflection
White	Oil	65.7
Extremely faint cream	Oil	64.0
Light cream	Oil	52.8
Light cream	Water	52.0
Very faint greenish	Oil	46.0
Very faint greenish	Water	45.8
Faint gray	Oil	45.6
Pale-gray buff	Water	44.0

Unfortunately, direct readings on a photometer could probably not be made with great accuracy on very dark paints or on those with a very high enamel-like lustre. The necessity of devising more appropriate means of measuring the light-reflecting powers of paints which could be used for all shades and tints, as well as all degrees of matte and gloss surfaces, led the writer to experiment with a number of types of apparatus. Painted samples were prepared by sizing paper and applying two coats of a number of white and colored paints, of known composition. The apparatus that proved best for determinations of the "coefficient of reflection" is shown in Fig. 1. A disk 3¼" in diameter, coated with paint was placed at the centre of an integrating sphere and illuminated by light from a concentrated filament lamp shining through an opening in the top of the sphere. The light fell on the disk at an angle of 45° and the interior of the sphere received only light reflected by the paint. For standardization a flat block of magnesium carbonate (commercial) was substituted for the disk, its coefficient of reflection being taken at 88%, in accordance with the experiments of Nutting, Jones and Elliott The readings were made with a portable photometer, and the results are shown in the following tables.

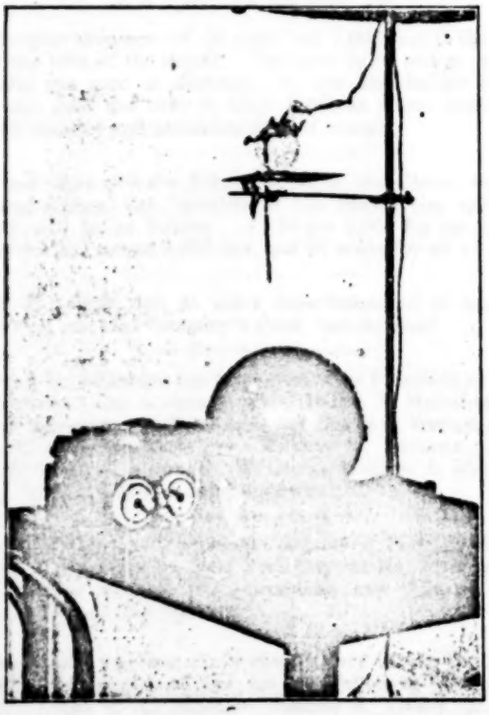


Fig. 1.—Apparatus for Determining Coefficient of Reflection of Painted Surfaces.

TABLE I.—*Effect of the Vehicle on the Coefficient of Reflection of White Paints.*

	Coefficient of Reflection.
Lithopone in dark-colored raw linseed oil	61
Lithopone in very light-colored flat varnish	67
White pigment mixture in light-colored semi-gloss varnish	66
White pigment mixture in light-colored gloss varnish	66
Special white pigment in flat varnish	61.2
Special white pigment in high-gloss varnish	61.2

TABLE II.—*Effect of Slight Tints on White Pigments Ground in Flat Varnish.*

	Coefficient of Reflection.
Pigmant A, free from impurities (very white)	66
Pigment AA, containing traces of iron giving yellow color	64
Pigment AA, tinted with ultramarine blue to correct yellow shade, producing slight greenish tint	64
Pigment A, with 1½% lampblack tinting color (light gray)	44
Pigment A, with 1% lampblack tinting color (gray)	27

TABLE III.—*Colored Paints.*

White pigment base, tinted with chrome yellow, chrome green, Prussian blue, para red, ochre sienna, carbon black, etc.

	Coefficient of Reflection.
Light cream	66
Light pink	60
Light yellow	58
Light blue	55
Light greenish yellow	54
Light buff	52
Light green	42
Light terra cotta	41
Medium terra cotta	39
Light greenish blue	36
Medium blue	32
Warm green	19
Medium green	14
Red	12
Blue, dark	12
Green	11

TABLE IV.

	Coefficient of Reflection.
Luminous calcium sulfid paint	54.4
Aluminum paint	48

The most interesting of the results are those on flat, semi-gloss and high-gloss paints, all of which apparently have substantially the same illuminating value when prepared of the same pigment with oils or varnishes of the same degree of color. This is an important development, since it allows the use of the type of paint best suited for the lighting equipment of a room; direct, semi-indirect, indirect, etc. Although flat paints may retain their whiteness longer, semi-gloss and gloss paints are preferable in many instances on account of their better wear under frequent washing.

Factory Illumination.—The illumination of factories, railroad terminals, and department stores, has been given great consideration of recent years; increased output, improved workmanship, and a minimum of accidents having resulted in nearly every instance where better lighting has been installed. In such places, wall treatment for conserving the illumination has generally been

adopted. From the standpoint of economy, it is of interest to record that the cost of lighting dark-walled factories may be considerably reduced by painting the interiors in light colors.

The customary process of treating factory walls is to first apply a coat of flat white paint, and latter a coat of gloss white. This is recommended when indirect or semi-indirect lighting fixtures are used, since the gloss finish prevents the lodgment of dust, and can be easily washed. For the ceilings, however, a flat or semi-gloss paint is better than a high gloss, since it distributes the light better. Where direct lighting fixtures are used with modern illminants, or older forms of illumination are installed, the flat or semi-gloss oil paints are advisable.

The question has been raised as to whether colored paints should be advised where direct lighting fixtures are used, since white is not always desirable under very strong light. For instance, the traveller approaching a tropical city sees the buildings painted blue, pink, green—in fact, every conceivable color. In Havana there are ordinances prohibiting white paints on the exterior of buildings, because of the glaring effect under the tropical sun. Similarly, in some factories a slight greenish or other tint might be desirable, since a small amount of colors may reduce the glare and not materially reduce the illumination. The tint to be used should, however, be studied under the light in the room, since artificial illumination of some types has a marked effect upon certain colors, giving them shades or tints entirely different from those observed in daylight or by other illuminants.

Schoolrooms, Public Buildings and Dwellings.—A. C. Rapp was the first to call attention to the necessity of careful selection of colors for schoolrooms, in order to bring out the greatest effort from the occupants. He quotes some experiments on students in rooms treated with various colors. The effects of the colors may be summed up as follows:

Black.—Melancholia. Decreased work.
Red.—Temporary stimulation followed by a reaction, accompanied by nervousness and headache.
Blue.—Calmness and seriousness.
Green.—Increased vitality. Happiness.
Yellow.—Increased vitality. Amiability.

That the same consideration should be given to wall colors for all public buildings, stores and dwellings as well, is apparent. The lighter tints of the desirable colors should be used, in order to increase the illumination, the darker colors for borders and dadoes to produce pleasing contrasts. These suggestions are in line with those advanced by Parsons and Smith, who studied the physiological effect of colors in study-rooms at the United States Naval Academy. They advocated white ceilings slightly tinted with yellow, and light greenish-yellow walls which by tungsten light would be a pleasing green color.

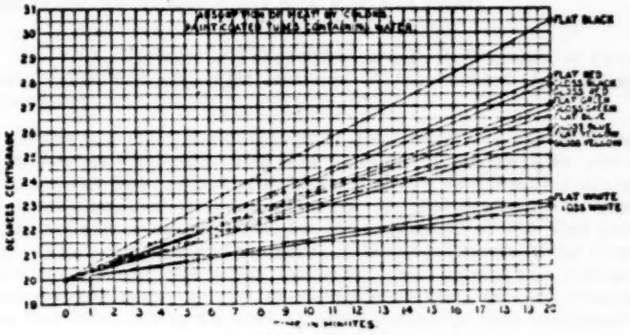


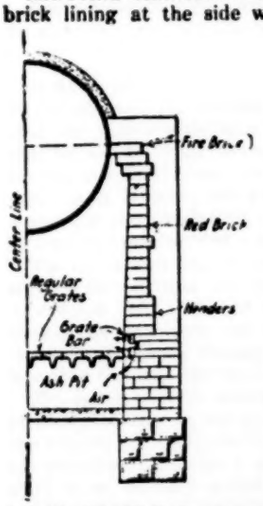
Diagram I.

Temperature of Colored Surfaces.—Dark-colored paints absorb heat rays as well as light rays. Even a small amount of black in a white paint makes a great difference in the heat absorption. The writer and L. P. Hart have conducted some tests on colors used by the grinder in producing colored paints on a white base. In one series of tests the colors were ground in linseed oil to a stiff paste, and placed in glass tubes upon which the rays of a powerful nitrogen-filled Mazda lamp were focussed. In another series the outside of the tubes was painted with the same colors to produce a glossy surface, or, ground in turpentine, to produce a flat surface, 10 c.c. of water being placed in each tube. The rise in temperature of the water is recorded in Diagram I. The colors used were as follows:

Paranitraniline red (20% on calcium carbonate base).
Chrome yellow, 100%.
Prussian blue, 100%.
Dark green (100% mixture of blue and yellow).
Medium green (20% dark green on barium sulphate base).
Black (100% carbon black).
White (white lead and white zinc, 50% each).

New Methods and Appliances.

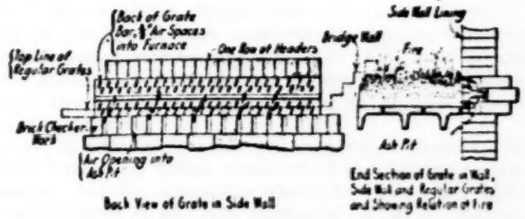
REDUCING MAINTENANCE COST IN BOILER FURNACES.—The firebrick lining at the side walls in a coal-burning furnace, in the region included between the level of the grates and fire line, requires constant attention and repairs. After using standard methods of installing firebrick and trying out special blocks and tiles with different fireclays and mortars, the writer has devised a method of construction that has given 5 years service with no expense for repairs.



Special Side Wall Construction of Furnace.

The main cause of deterioration of furnace lining is high temperature, resulting in fusing of brick, other causes being contraction and expansion with changes of temperature, the scarifying action of slag aud clinkers, and abrasion from fire tools in knocking off clinkers.

A construction to overcome this trouble is shown in the accompanying illustrations. Two discarded herringbone grate bars 6" wide with 3/4" air spaces were used, one set in each side wall, with the face of the bar flush with the firebrick lining. A heavy grate bar is required, and to prevent warping and burning out the lower edge is set slightly below the top of regular grate, and rests on a checkerwork of brickwork opening into the ash pit. This construction allows air to pass in around the back of the grate bar from the ash pit, then through the grate bar into the furnace.


Back of Grate Bar, 3/4" Air Spaces into Furnace
Side Wall Lining
Bridge Wall
Top Line of Regular Grates
One Row of Headers
Fire
Brick Checker-work
Air Opening into Ash Pit
Ash Pit
Back View of Grate in Side Wall
End Section of Grate in Wall, Side Wall and Regular Grates and Showing Position of Fire

CHARLES M. CREWE, in "Electrical World."

CEMENT JOINTS IN WATER MAINS.—It has been the practice for more than 20 years in the water works of the city of Los Angeles to lay cast iron pipe with cement joints; as they say it gives a better joint and fully as flxible a joint as obtained with lead. They do not claim that the idea originated with them, as it was the common practice in many old water works, where cement-lined pipes were used, to join them with sleeves having cement packing.

The water works of Los Angles were begun in 1868, and they have bell end gates packed with cement in the 8" cast iron line that originally formed the trunk line for the city supply.

In 1895 they laid a 30" line of cast iron pipe that subsequently had to be lowered at three different points for distances ranging from 200 to 800 feet in length.

At one of these places the pipe was lowered nearly 7 feet at its maximum point of displacement, and this was done without cutting a single joint.

Although the pipe wabbled considerably out of alignment in the operation, the seeping leaks caused by the movement all took up automatically without further attention.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE JOURNAL'S English Correspondent, Mr. Norton H. Humphrys, retired engineer and manager of the Salisbury Gas Works, was asked to meet the employees in the general office during an interval between the retort-house charges, a time that would admit of the whole number being present. Mr. William Fielden, the new engineer and manager, presided. The "Journal of Gas Lighting" reports the meeting as follows: Mr. J. C. Watts, as the oldest employee of the company and works foreman, when called on by the chairman, said many of the staff had enjoyed the advantage of being associated with Mr. Humphrys for quite a long period—one or two, himself among the number, could remember welcoming that gentleman on his arrival in Salisbury in 1883—and they all felt that his connection with them should not be closed without some recognition of the good feeling that had at all times existed between them. Consequently he now had the very great pleasure, on behalf of the whole working staff, of asking Mr. Humphrys to accept with their best wishes an illuminated address, together with an umbrella for Mrs. Humphrys. The address was as follows: "Presented to Norton H. Humphrys, Esq., A.M.Inst. C.E., F.C.S., by the undermentioned officers and staff of the Salisbury Gas Light and Coke Company on his retirement after thirty-two years' service, as a token of their regard and appreciation of his many thoughtful acts of kindness to them, with every good wish for his future health, happiness and prosperity. 30th September, 1915." The handle of the umbrella was elegantly mounted in gold Mr. J. W. Frost (accountant), Mr. T. W. Crowdy (manager's assistant), Mr. G. Bowering (outdoor foreman) and others having spoken in similar terms. Mr. Humphrys said that he could not find words that would adequately express all that he would like to say on receiving from his old friends such a splendid recognition of their regard and esteem, which was accepted with as much pleasure as they had expressed in presenting it, and would always have an honored place in his home. Mrs. Humphrys was not yet aware of their kindness to her, but he was sure that he could say on her behalf that she would also be very much pleased with the valuable and useful present, and that she would value it highly.

AT the annual meeting, held at the office of the Coldwater, Mich. Gas Light and Fuel Company, on Jan. 17, the following rates were decided upon:

Minimum charge, 50 cents
First 1,000 feet, $1.30
Next 3,000 feet, 1.10
Next 1,000 feet and over, 90c.

with a further discount of 10 cents per 1,000 feet if the bills are paid by the 10th of the month. The new rates will go into effect on bills for gas used in January. It was also decided that merchants who used gas arcs in their business places would be furnished all mantles and glassware free of charge.

THE new rates effective Feb. 1, 1916, in the Chico, Marysville, Napa, and Colusa, Cal., districts of the Pacific Gas and Electric Company, will be as follows: $1.50 per 1,000 for the first 5,000 feet; $1 for the second 5,000 feet, and 80 cents for all over 10,000.

G. H. BURNETT, for 25 years Superintendent of the Lansing (Mich.) Fuel and Gas Company's plant, has resigned.

WILLIAM H. BURROWS has been elected as President of the Middletown (Conn.) Gas Company, while Henry L. Mansfield is continued as Secretary and Treasurer, and Edgar C. Weston as Superintendent. The directors are, William H. Burrows, Henry L. Mansfield, Frank C. Smith, D. W. Camp, William S. Pardee, Edward K. Bradley and J. Gordon Baldwin.

THE Northwest Gas Equipment Company of Portland, Ore., have opened a branch office in New York City, at No. 71 Broadway, in charge of H. R. Kingman, vice-president, and Wm. F. Hoecker, assistant secretary and treasurer.

AT the annual meeting of the stockholders of the Hartford City Gas Light Campany held Jan. 18, the following directors were elected: Judge E. B. Bennett, Francis R. Cooley, Morgan G. Bulkeley, Jr., Frank C. Sumner, James H. Knight, Philip B. Simonds, J. J. Bodell, George Roberts, John T. Robinson. Executive officers were re-elected as follows; President, Judge E. B. Bennett; vice-president, Francis R. Cooley; secretary and treasurer, John A. McArthur; assistant secretary, J. T. Robinson; assistant treasurer, W. A. Kneeland; general manager, Benjamin W. Perkins.

THE Ludington (Mich.) Gas Company held its annual meeting recently and elected the following officers: Charles N. Remington, president; Andrew Fyfe, vice-president; Charles A. Coye, secretary, and Henry L. Adzit, treasurer. These men, with Oscar B. Wilmarth, constitute the board of directors.

ANOTHER convert to free maintanance is Mr. H. W. Easterly, manager of the Sheboygan (Wis.) Gas Light Company. This work will be started on February 1, with Joseph Lesher as head inspector.

AT a meeting of the stockholders of the Attleboro (Mass.) Gas Light Corporation January 14, the following named officers were elected: Wm. C. Davenport, president; Walter T. Soper, treasurer. Directors—Wm. C. Davenport, Walter T. Soper, Frank L. Tinkham, Charles W. Davol, Henry F. Bassett, Everett S. Capron, James E. Blake; Wm. J. Luther, clerk of corporation and superintendent.

MORE office space will be avilable for Henry L. Doherty and Company who have added to their space at 60 Wall street, New York City, by leasing the entire ground floor of this building which extends from Wall to Pine streets.

THE Omaha (Neb.) Gas Company has elected the following directors: Frank T. Hamilton, W. F. Douthirt, George W. Clabaugh, George E. Barker and Fred P. Hamilton. Officers elected are: President, Frank P. Hamilton; vice-president and secretary, G. W. Clabaugh; treasurer, Louis Lillie; assistant treasurer, L. W. Weymuller; assistant secretary, I. W. Morris.

ALMOST any public service man will agree as to the wisdom of booming the territory his company serves, but the real question is "What does he do about it?" The Gardner (Mass.) Gas, Fuel and Light Company, not being content to simply appreciate all to itself that Gardner is the largest chair manufacturing community in the world, wishes to advertise this important fact all over this great country of ours, and, therefore, the management of the Gardner company proposes to accomplish all this by a "Made in Gardner" exhibit. Since such a proposition as this requires the co-operation of all the Gardner manufacturers, as well as all of its public men, invitations were issued by the Gardner company to these men to be its guests at an informal dinner and smoker, held on the evening of Jan. 11, at the Windsor House, Gardner, and was a success in every way. After the dinner, Mr. A. A. Laughton, local manager of the gas company, called the gathering to order, and introduced Mr. Bowen Tufts, of Boston, one of the directors of the company, who spoke on the subject, and called upon many of those present for their comments and other general remarks. All of the manufacturers were urged to vie with each other in creating the most attractive booth which would display their goods. It was further suggested that these booths could then be photographed and sent to various trade publications, with a statement about the matter. The trade papers, in publishing copies of the photographs of these booths, and in articles descriptive of the affair, would in this way give national publicity to the project. Also, valuable community advertising material would be furnished the local Business Men's Assciation, such as could be used in its campaign of advertising and booming Gardner. As a result of the dinner, much real appreciation was extended to the gas company, and everywhere was it indicated that all would co-operate to make the proposed exhibit worthy of Gardner. It is planned to hold the exhibit early in the Spring.

SUPERINTENDENT Robert E. Freel, of the Clinton (Mass.) Gas Light Company has offered prizes for the best compositions on the subject, "Progress in Domestic Science—Cooking by Gas," to be written by domestic science pupils of the eighth and ninth grades. There will be one prize for the best composition in each grade. The composition may take the form of an essay, a narrative of personal experience, or a poem, as the pupil desires. It should contain approximately 500 words, and must be completed by February 14, 1916. The judges of the excellence of the compositions will be appointed by the superintendent of schools. The prizes to be given

will be on exibition in the display window of the Clinton Gas Light Company.

THE Stetson Club, composed of employees of the New Bedford (Mass.) Gas Company, held its annual meeting January 19 in the Gas Company building. Officers were elected, and an entertainment followed. The officers elected were as follows: President—David W. Beaman. Vice-president—Robert Lindsay. Secretary-treasurer—Philip Sherman. Directors—Joseph Langfield, Southard Negus, J. Henry Parker, Herbert L. Bragdon. Auditors—Edward L. Potter, Everett W. Cole, James Readio.

GEORGE MCKNIGHT, superintendent of the gas department of the Athol (Mass.) Gas and Electric Company, has resigned his position, to take effect the middle of next February. Mr. McKnight has been with the company 25 years.

THE Suburban Gas and Electric Club, composed of the Revere (Mass.) employees of the Suburban Gas and Electric Company, held its annual dinner January 11 at the company's garage, with about 75 at the tables. The young women clerks were guests. Vice-president Alfred Gardella made an address of welcome and the dinner was followed by moving pictures, vaudeville and dancing.

A FREE Maintenance Service was inaugurated on January 17 by the Holyoke (Mass.) Municipal Gas and Electric department for the benefit of consumers of both gas and electricity. The service will be maintained from 8 o'clock in the morning until midnight. Michael J. Kingsley will inspect all gas fixtures and equipment while Arthur H. Keeney will attend to the electrical end of the service. Minor repairs will be made free of charge and the experts can also be consulted by housewives as regards improving lighting facilities in their homes. The experts will install anything from a gas mantle to a gas stove.

MR. H. D. WOOD, of New Bern (N. C.) has been appointed receiver for the Goldsboro and New Bern Gas Plants.

MR. C. A. TRUMBY, of Philadelphia, and C. B. Wagoner, of Concord, have been appointed receivers of the Concord (N. C.) Gas Company.

WHEN S. J. Dill, vice-president of the United Gas and Electric Engineering Corporation left New Orleans, La., on the 13th, after a 9 months' stay, he took with him a token of the friendship of the persons connected with the company. It was presented to him Tuesday afternoon the 11th, by the employees of the Gas and Electric Corporation and the heads of the departments of the New Orleans Railway and Light Company. The present was a silver after-dinner coffee service of exquisite design. Mr. Dill returns to New York city as his work at New Orleans has been completed.

OFFICERS and directors of the Massillon (O.) Electric & Gas Co., were re-elected at the annual meeting Jan. 11, as follows: H. L. Doherty, New York, president; Frank Frueauff, New York, vice-president; T. O. Kennedy, second vice-president, treasurer and general manager; W. E. Russell, secretary, and F. W. McKenzie, assistant secretary. The directors are: H. L. Doherty, Frank Frueauff, I, M. Taggart, J. A. Shaidnagle, W. E. Russell, F. W. McKenzie and T. O. Kennedy.

UTILITIES COMMISSION NEWS.

THE BOSTON SLIDING SCALE GAS ACT.—The gas and electric light commission in a preliminary report on the resolve of the last legislature directing it to investigate the operation of the system of an automatic and inter-dependent adjustment of the price of gas to consumers and the rate of dividends to stockholders known as the "London sliding scale" as applied to the Boston Consolidated Gas Co., states that the board's expert accountant has not been able to complete his report. The board, therefore, requests that time for submission of its report be extended to March 1.

MORE CALIFORNIA BONDS.—The California railroad commission has authorized the Pacific Gas and Electric Company to issue $2,500,000 6% first preferred stock and $2,000,000 5% general and refunding bonds. The stock must net the company not less than 90 and the bonds not less than 85 and accrued interest.

SAMUEL INSULL SPEAKS.—Samuel Insull, Chairman of the Board of Directors of the Peoples Gas Light and Coke Company, Chicago, told the council committee on gas, oil and electric light Jan. 20th, that he will be ready to talk figures as soon as the company's books for the last fiscal year are audited. That task will be completed this month, he said, and within a few days he will put into writing a plan for the production of coal gas instead of water gas, and its sale to all consumers at a rate less than the present rate.

The conference put an end to all discussion of the possibility of settling the pending gas rate litigation. Both Mr. Insull and the committee held that the case before Judge Frederick A. Smith should run its course, and that it need not interfere with negotiations aimed toward dropping the candle power requirements and lowering the rate for the future.

Mr. Insull told the committee of his company's plan for a complete revaluation of its properties, which was adopted because of the attitude of the State Public Utilities Commission, and expressed his willingness to have a gas engineer representing the city take part in, or, as least, watch the inventory. The committee indicated its intention of accepting the offer.

The question whether the company would open its books during the consideration of future rates, became entangled in the question whether information thus gained by the city would be used in building up its court case. Mr. Insull expressed his willingness to furnish all the facilities at his command for future inquiries, but because of the tangle he said he could not make a definite statement concerning the books until he has consulted his counsel.

A statement on this phase of the subject will probably be included in the "memorandum" of the company's proposition to be submitted by Mr. Insull.

He branded the present candle power system as extravagent. "Less than 2% of the gas we now sell is used on the candle power basis," he said, "that is in the open, flat burner for direct lighting. If the heat value basis were substituted and the flat burners replaced with mantle burners, the users of that 2% would not only get their gas at a lower price, but they would get better light. The other 98% now are paying for a candle power value they do not need, and from which they receive no benefit."

THE GAS COMPANY FALLS BACK ON THE COMMISSION.—Lewiston, Me., is trying to obtain cheaper gas rates, a committee from the city government having been appointed recently to investigate the matter and confer with the gas company. The latest development occurred January 12, when the gas company expressed willingness to submit the matter of reasonableness of its rates to the Public Utilities Commission.

The city government committee recently addressed a letter to President Wallace H. White, president of the Lewiston Gas Light Co., stating that the committee wished to make a fair and intelligent investigation of all facts connected with the matter. Mr. White was invited to come before the committee and submit to such examination as the committee may wish. The committee expressed the belief that gas rates were excessive and that a substantial reduction can properly be granted.

In his reply, Mr. White says that the company does not believe that its rates are excessive, and objects to appearing before the committee, alleging that the minds and the members are all made up that the rates are unreasonable and that therefore he could not count a fair hearing. He says that he is willing to submit the matter of reasonableness of rates to the Public Utilities Commission.

DAYTON, O., VALUATION.—The city of Dayton, O., through its representative William J. Hagenah, Chicago engineer, has estimated the present value of the Dayton Gas Company at $1,963,149 and the reproductive value at $2,440,238. These facts are included in the statement filed with the Ohio Public Utilities Commission on January 18. The valuations were made by Wm. Hagenah as an employee of the city commission.

The gas company's estimate of its present value, filed with the commission recently, is $2,289,708 and the reproductive value, $2,690,752. The hearing of the case from both standpoints by the state commission will take place February 1.

Financial Notes.

AN increase of nearly 11% was shown by the PUBLIC SERVICE CORPORATION of New Jersey, in gross business for December as compared with the corresponding month of the year previous. The gross income for the year showed an increase of 5%. The corporation's statement follows:

Public Service Corporation of New Jersey.

Month of December, 1915.

Gross increase in total business	$345,889.19
Percentage of increase	10.8%
Ballance available, after payment of operating expenses, fixed charges, sinking fund requirements, etc., for amortization, dividends and surplus	593,095.36
Increase in surplus available for dividends over corresponding month, 1914	44,971.48

Twelve months ending December 31, 1915.

Gross increase in total business	$1,781,395.34
Percentage of increase	5.0%
Balance available, after payment of operating expenses, fixed charges, sinking fund requirement, etc., for amortization, dividends and surplus	4,065,433.74
Increase in surplus available for dividends over corresponding period, 1914	263,215.97

THE total special franchise valuations placed upon the corporations operating in New York city by the State Tax Commission for 1916, is $459,755,850, an increase of $41,970,700 over 1915. The highest valuation fixed is $105,010,000 upon the Consolidated Gas system. Other valuations include Brooklyn Union system, $44,061,000; Brooklyn Rapid Transit system, $43,043,900; Third Avenue system, $25,440,000; Empire City Subway Company, $11,963,000; New York Telephone Company, $53,332,000; New York and Harlem Railroad Company, $19,063,600; New York Central Railroad Company, $5,253,700; New York Connecting Railroad Company, $2,778,000; Pennsylvania Tunnel and Terminal Railroad Company, $18,066,600. These valuations all show increases over 1915, the biggest increase being $14,240,000 on the Brooklyn Union system. Several decreases also are indicated, the New York Railroad system and the Manhattan Railroad Company, for instance, both being decreased over $5,000,000. The total increases amount to $53,366,900, and the decreases total $11,396,200, giving the net increase over 1915 of $41,970,700.

IT took two vice-chancellors to determine that the sale of the DOVER, ROCKAWAY AND PORT ORAM, (N. J.) GAS COMPANY to Edwin Hawley Van Wyck, of Cranford, for $110,000 should be confirmed. Vice-Chancellors Stevens and Howell sat together recently and listened to a plea voiced by Edward M. Colie, called in as solicitor at the last minute, for an adjournment of the confirmation of the sale. Voicing the opinion of himself and Vice-Chancellor Howell, Vice-Chancellor Stevens said that the limit of judicial indulgence had been reached and the sale should be confirmed. Application for confirmation of the sale was first made to Vice-Chancellor Stevens as long ago as November 30. At that time Addison Ely, sr., president of the company, pleaded for an adjournment, declaring that the amount obtained at the sale by the sheriff of Morris County was entirely inadequate and that the sale had not been advertised properly. He urged that if a sufficient adjournment was had he could obtain a bidder who would pay a much larger sum for the plant. The vice-chancellor gave him four weeks in which to obtain a higher price. Within a few days Mr. Ely contracted pneumonia, and became unconscious. He has been unable to attend to business since then, and two weeks ago Addison Ely, jr., sought another adjournment. Two weeks further was granted by the court, and it was announced last Tuesday that a bidder had been found who would pay $135,000 for the property. Still two days further was granted, but to-day another extension was asked. "There has been a great deal of unwarranted delay in this matter," said Vice-Chancellor Stevens. "Although Captain Ely had a very large amount at stake, he made no effort to protect himself until after the sale was held. I think, and Vice-Chancellor Howell agrees with me, that the extreme limit of indulgence has been reached." The property was sold under foreclosure proceedings brought by the Fidelity Trust Company, as trustee, under a second mortgage for $90,000.

THE combined net earnings available for dividends of the subsidiary companies of MASSACHUSETTS GAS in December totalled $295,266, the largest in any month since organization. The gain in net in December was $50,714, or 20.74%. The $50,714 increase last month was more than sufficient to wipe out the $6,916 decrease in January, 1915; $10,067 decrease in September and the drop of $30,439 in October earnings. Massachusetts Gas has recently been benefiting very materially by the improvement in prices for coal and coke. The cold weather has also greatly increased the consumption of gas. The common stock dividend of $1.25 payable February 1, will be distributed to approximately 5000 stockholders, which is three times the number of a decade.

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